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The Fifty-Second Annual Report

OF THE

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UNIVERSITY OF MARYLAND

Agricultural Experiment Station

College Park, Prince George's County, Maryland

1938-39

PUBLISHED BY THE STATION

The University of Maryland
Agricultural Experiment Station

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G. F. Madigan, Ph.D., Instr. Soil Tech.
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Albert White, B.S., Assistant, Agron.
A. D. Hoadley, M.S., Assistant, Agron.

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DeVoe Meade, Ph.D., Prof. Dairy Husb.
M. H. Berry, M.S., Assoc. Prof. Dairy Husb.
C. W. England, Ph.D., Prof. Dairy Mfg.
F. H. Leinbach, M.S., Prof. Animal Husb.
K. L. Turk, Ph.D., Prof. Dairy Husb.

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A. L. Brueckner, B.S., D.V.M., Prof. Path.
H. M. DeVolt, M.S., D.V.M., Assoc. Prof. Path.
L. J. Poelma, M.S., D.V.M., Assoc. Prof. Path.
Morton Rabstein, B.S., V.M.D., Asst. Prof. Vet. Sci.

BACTERIOLOGY.

L. H. James, Ph.D., Prof. Bact.
H. L. Bodily, Asst. Prof. Bact.

BOTANY, PLANT PATHOLOGY AND PHYSIOLOGY.

†C. O. Appleman, Ph.D., Prof. Bot. & Plt. Phys.
J. B. S. Norton, D.Sc., Prof. Botany
C. E. Temple, A.M., Prof. Plant Path.
Ronald Bamford, Ph.D., Prof. Botany
R. A. Jehle, Ph.D., Assoc. Prof. Plt. Path.
R. G. Brown, Ph.D., Assoc. Prof. Plt. Phys.
H. G. DuBuy, Ph.D., Asst. Prof. Plt. Phys.
M. W. Woods, Ph.D., Asst. Prof. Plt. Path.
E. A. Walker, M.S., Asst. Plt. Path.
H. G. Shirk, Ph.D., Asst. Plt. Phys.

ENTOMOLOGY.

E. N. Cory, Ph.D., Prof. Ento.
H.S. McConnell, M.S., Assoc. Prof. Ento.
L. P. Ditman, Ph.D., Asst. Prof. Ento.
Castillo Graham, Ph.D., Asst. Prof. Ento.
G. J. Abrams, M.S., Inst. Apiculture.

HORTICULTURE.

A. L. Schrader, Ph.D., Prof. Hort.
C. H. Mahoney, Ph.D., Prof. Oler.
E. P. Walls, Ph.D., Prof. Canning Crops
I. C. Haut, Ph.D., Assoc. Prof. Pomol.
F. B. Lincoln, Ph.D., Assoc. Prof. Plt. Prop.
T. H. White, M.S.. Instr. Veg. Gard. & Flor.
S. B. Chase, M.S., Asst., Pomol.
J. B. Blandford, Asst., Hort.
Jack Amatt, B.S., Inst., Plt. Prop.

POULTRY HUSBANDRY.

M. A. Jull, Ph.D., Prof. Poult. Husb.
T. C. Byerly, Ph.D., Prof. Phys.
G. D. Quigley, B.S., Assoc. Prof. Poult. Husb.
H. R. Bird, Ph.D., Asso. Prof. Poult. Husb.

SEED INSPECTION.

F. S. Holmes, M.S., Seed Inspector.
Ellen P. Emack, Seed Analyst.
Olive M. Kelk, Seed Analyst.

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†Dean of Graduate School.

The Station is located on the B. & O. R. R., City and Suburban Electric Car Line and the Baltimore-Washington Boulevard, eight miles North of Washington, D. C. Telephone—Greenwood Exchange.

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Station in all its departments.

The Bulletins and Reports of the Station will be mailed free of charge to all residents of the State who request them.

ADDRESS:
AGRICULTURAL EXPERIMENT STATION,
COLLEGE PARK, MARYLAND.

The Fifty-Second Annual Report

OF THE

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UNIVERSITY OF MARYLAND

AGRICULTURAL EXPERIMENT STATION

Volume 52 1938-1939

THE FIFTY-SECOND ANNUAL REPORT OF THE UNIVERSITY OF MARYLAND AGRICULTURAL EXPERIMENT STATION

For The Fiscal Year Ending June 30, 1939

By J. E. METZGER, *Director*

To the Governor of Maryland, the Board of Regents, and the President of the University of Maryland:

I transmit herewith the Fifty-second Annual Report of the University of Maryland Agricultural Experiment Station, as established by Act of Congress, March 2, 1887, containing an account of research and experiments of the Station for the fiscal year ending June 30, 1939, and a statement of the receipts and disbursements for the period.

The rural people of Maryland receive cash income from many kinds of crops, animals and animal products. In fact, there is produced in the State commercially, almost every kind of crop and animal product. The Station's research program touches upon many of these agricultural enterprises but it is not possible to support major studies on all of them continuously. Most agricultural problems requiring the application of research procedure are complicated, and their solution generally consists of taking away rather than adding to or increasing the complexities. When a study has progressed to the point where there is nothing more to be removed and when the facts are presented in a form in which the producers for whom they are intended can understand and use them, then science as applied to agricultural problems has reached its goal. To attain this purpose, it is necessary at times to concentrate the efforts of individuals in different sciences upon a single problem. Such integration of the work of the Station has proven especially helpful in approaching the studies on a broader basis than is possible by any particular group of workers.

Much progress was made during the year in a number of the investigations, and valuable service was rendered in connection with current problems. The workers in Agricultural Economics made extensive studies on taxation and revenue; on state-wide highway planning; on marketing studies in poultry, vegetables and fruit; and on cooperatives. In Agricultural Engineering a grain drier that is destined to become an indispensable supplement to the combine in the handling of the winter grain crops of the State, was designed and built. It should prove especially valuable in preparing seed grain for storage until planting time. In Agronomy and Horticulture the major efforts were devoted to the inauguration and development of the experimental work on the new research farms. Work was continued on the quality of canning crops and studies were begun on the quick freezing of vegetables and dressed poultry. The hybrid barley, Marnobarb, attained major commercial use and the acreage of this crop (seventy thousand acres) is now more than half the estimated requirement for the State. The new poultry plant and building were completed during the year. The work in poultry marketing, breeding and nutrition, especially the latter, was unusually productive. The developments in the utility of vegetable sources of vitamins was perhaps the most important of these contributions.

Some agricultural problems are common to a much wider area than a single state. In such instances it is desirable to make joint studies with other states or with the Federal Department of Agriculture. The inter-state studies in progress are on fruit tree rootstocks, produce transportation, tax studies, and studies on the durability of wool, silk, rayon and cotton fabrics for women's and children's wearing apparel. A total of thirty-four research projects are now supported jointly by the United States Department of Agriculture and the Maryland Station. These projects are distributed among the subject matter departments as follows: Agricultural Economics, six; Agricultural Engineering, one; Agronomy, eight; Animal Husbandry, two; Animal Pathology, two; Botany, four; Entomology, three; Horticulture, six; and Poultry, two. The studies cover land use, soil conservation, animal and plant diseases, insect control, and new uses and methods of handling food and feed commodities. In addition the Station receives support from a number of commercial firms for the investigation of special problems in agriculture closely related to their manufacturing interests.

CHANGES IN PERSONNEL

Mr. Thomas Herbert White of the Department of Horticulture retired from active duties November 1, 1938, after forty years of splendid service on the staff of the Maryland Agricultural Experiment Station. Born in England in 1868, Mr. White came to the United States in 1888, was appointed on Station duties in horticulture in 1898. As Olericulturist and Floriculturist from 1912 to 1938, his experimental studies on vegetables and flowers resulted in numerous invaluable contributions to the agricultural field of knowledge and practice. A long list of journal articles and station bulletins leave a well-marked trail of his success in his career of research. To cite one noteworthy result of his efforts, the Maryland Golden sweet potato, an improved variety in yield and quality, was introduced in 1930 and now is widely planted in Maryland and nearby states, to the benefit of both farmer and consumer. In his long service for agriculture of the State of Maryland, Mr. White has repeatedly made similar worthwhile accomplishments that gained him wide recognition among agricultural workers and producers, as well as a host of friends.

Resignations

James W. Coddington, Assistant Professor of Agricultural Economics, resigned to accept a position in the United States Department of Agriculture.

J. Russell Ives, Assistant in Agricultural Economics, resigned to accept a position in the United States Department of Agriculture.

Roy E. Huffman, Assistant in Agricultural Economics, resigned to accept a position with the Farm Security Administration of the United States Department of Agriculture.

Spencer Chase, Assistant in Horticulture, resigned to accept a position with the Tennessee Valley Authority.

William Gochenour, Jr., Assistant in Animal Pathology, resigned to accept a position in the Pittman Moore Laboratories, Indianapolis, Indiana.

Appointments

Jack Amatt, B. S., Instructor in Horticulture.

Howard Stier, Ph. D., Assistant in Horticulture.

Morton M. Rabstein, V. M. D., Assistant in Animal Pathology.

Herbert R. Bird, Ph. D., Associate Professor of Poultry Nutrition.

PUBLICATIONS

Bulletins

Number	Title	Author
420	Physiological Studies on the After-Ripening and Germination of Fruit-Tree Seeds	I. C. Haut
421	An Economic Survey of Farm Orchards in Counties Near Baltimore, Md., and Washington, D. C.	Spencer B. Chase A. L. Schrader
422	Standard of Living on Carroll County Maryland Farms	Viola C. Teeter Carl B. Smith
423	Manual for Milk and Cream Testers in Maryland	C. W. England
424	An Economic Study of Land Utilization in the Tobacco Area of Southern Maryland	James W. Coddington David E. Derr
425	Variety and Strain Trials of Alaska and Sweet Types of Peas for Canning in Maryland	C. H. Mahoney W. A. Frazier H. A. Hunter Albert White
426	An Economic Study of the Hatchery Industry in Maryland	P. R. Poffenberger S. H. DeVault

Scientific Journals

Number

484 Ditman, L. P., Cory, E. N. and Graham, C. Studies on Pea Aphid Control. Jour. Econ. Entomology, Vol. 32, No. 4. 1939.

485 Frazier, W. A. Varietal, Climatic and Age Influences in Daily Cracking Indices of Tomato Fruits. Proc. Amer. Soc. Hort. Sci. 36, 1938.

486 Schrader, A. L. and Haller, M. H. Comparison of Wetting Agents in Apple Washing. Proc. Amer. Soc. Hort. Sci. 36, 1938.

487 Hesse, C. O. and Hitz, C. W. Maturity Studies with Jonathan and Grimes Golden Apples. Proc. Amer. Soc. Hort. Sci. 36, 1938.

488 Hitz, C. W. and Haut, I. C. Effect of Certain Waxing Treatments at Time of Harvest Upon the Subsequent Storage Quality of Grimes Golden and Golden Delicious Apples. Proc. Amer. Soc. Hort. Sci. 36, 1938.

489 Stier, H. L. and duBuy, H. G. The Influence of Certain Phytohormone Treatments on the Time of Flowering and Fruit Production of Tomato Plants under Field Conditions. Proc. Amer. Soc. Hort. Sci. 36, 1938.

490 Stier, H. L. Response of the Tomato (Lycopersicum esculentum, Mill. var. Marglobe) to Certain Vernalization Treatments. Proc. Amer. Soc. Hort. Sci. 36, 1938.

491 Van Horn, C. W., Schrader, A. L. and Haut, I. C. Root and Crown Development of Strawberries. Proc. Amer. Soc. Hort. Sci. 36, 1938.

492 Lincoln, F. B. Some Apple Tree Stock Relationships Seen in New England After the 1938 Hurricane. Proc. Amer. Soc. Hort. Sci. 36, 1938.

493 Gwin, J. M. An Economic Analysis of Cooperative Egg Marketing. Proc. Seventh World's Poultry Congress, 1939.

494 Bamford, Ronald. Chromosome Numbers in Some Tulip Hybrids. Botanical Gazette (accepted for publication May 15, 1939).

496 duBuy, H. G. Metering Pump and Turntable Arrangement for Supplying Measured Quantities of Nutrient Solution Successively to any Number of Culture Vessels. Jour. of Plant Physiology, 1939.

497 Ditman, L. P. and Weiland, G. S. The Metabolism of the Corn Ear Worm. II. Glycogen and Moisture. Annals of the Entomological Society of America, Vol. 31, No. 4, 1938.

498 DeVault, S. H. Review of "Economic Studies of Poultry Farming in New York. I. Commercial Poultry Farms." (Cornell Agricultural Experiment Station Bulletin No. 684, by E. S. Misner and A. T. M. Lee, 1937). Jour. Farm Economics, November, 1938.

499 Graham, C. and Cory, E. N. Field Tests on the Control of the Pea Aphid. Jour. Econ. Entomology, Vol. 32, No. 4, 1939.

Miscellaneous Periodicals and Proceedings

Number

666 Bamford, Ronald. Gladiolus Studies at the University of Maryland. New England Glad. Soc. Yearbook, 1938.

667 Ditman, L. P. Practical Aspects of Pea Aphid Control. Proc. Penin. Hort. Soc. 1938.

668 McConnell, H. S. Spray Injury Studies in Maryland. Proc. Penin. Hort. Soc., Vol. 28, No. 5, 1938.

669 England, C. W. Sanitation and Control (Part I). Ice Cream Field, Vol. 32, No. 7, 1938.

670 England, C. W. Sanitation and Control (Part II). Ice Cream Field, Vol. 32, No. 8, 1938.

671 Rothgeb, R. G. and Hoadley, A. D. Hybrid Corn Trials in 1938. Mimeographed circular, December, 1938.

672 McConnell, H. S. Spray Injury Experiments in Maryland. Proc. Md. State Hort. Soc. 1939.

673 Chase, Spencer B. A Survey of Newer Apple and Peach Varieties in Maryland. Md. Fruit Grower, Vol. 9, No. 2, 1939.

674 Schrader, A. L. Plant Thinning (Spacing) of Strawberries as It Affects Yields, Plant Growth and Cultural Methods. Trans. Penin. (Md-Del) Hort. Soc., Vol. 28, No. 5, 1938.

675 Walls, E. P. New Varieties of Vegetables and How They Behave in Maryland (Lantern). Trans. Penin. Hort. Soc., Vol. 28, No. 5, 1938.

676 Mahoney, C. H. Cantaloupe Breeding and Strain Development. Trans. Penin. Hort. Soc., Vol. 28. No. 5, 1938.

677 Walls, E. P. and Kemp, W. B. Preliminary Report on the Use of the Tenderometer in Forecasting Grades of Alaska Peas for Canning. Mimeographed circular, February, 1939.

678 Mahoney, C. H. Meeting Maryland Problems in Vegetable Growing. Proc. Penn. Veg. Growers' Assn. 1939.

679 Schrader, A. L. Some National Aspects of our Orchard Cultural Practices. Proc. Penn. Nut Growers' Assn. 1939.

680 White, T. H. Sweet Potato Root Studies. Proc. N. J. State Hort. Soc. 1938.

681 Walls, E. P. Exploratory Work in Canning Crops at the University of Maryland. The Canner, 88(1):17, 1938.

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683 Mahoney, C. H., Hunter, H. A., Cumings, G. A. and Schoenleber, L. G. Fertilizer Placement Results with Peas for Canning in Maryland. The Canners' School, 1939.

684 Holmes, F. S. Agricultural Seed Samples Collected in 1938. Printed circular, March, 1939.

685 Mahoney, C. H. and Brown, J. P. Variety Trials with Truck Crops on the Eastern Shore of Maryland, 1938. Mimeographed circular.

686 Cory, E. N. and Graham, C. What the Orchard Survey Disclosed in 1938. Trans. Penin. Hort. Soc., Vol. 28. No. 5, 1938.

687 Rothgeb, R. G. Hybrid Corn. Report of Md. Crop Imp. Assn. 1939.

688 Thomas, R. P. Observations of the Results of Rapid Soil Testing in Maryland. Report of Md. Crop Imp. Assn. 1939.

689 Byerly, T. C. Seasonal Factors Affecting Poultry Production in Maryland. Proc. Md. State Poultry Council, 1938-39.

690 Walker, W. P. et al. Preliminary Report of the Maryland State-wide Highway Planning Survey. Published by the Maryland State Roads Commission in Cooperation with the Bureau of Public Roads, U. S. Department of Agriculture.

691 DeVault, S. H., Walker, W. P. et al. Report of the Commission on Taxation and Revenue. Published by the Maryland Legislature.

692 Coddington, J. W. One Approach to Land Use Research. Land Policy Review.

693 DeVault, S. H. and Walker, W. P. Report of the Joint Tax Committee of the Maryland State Grange and the Maryland Farm Bureau, Inc., 1938-39. Mimeographed report.

Number

694 Coddington, J. W. Organization Plan for Agricultural Land Use and Program Building Committees for Maryland. Mimeographed report, August, 1938.

695 Coddington, J. W. Tentative Work Outline for Agricultural Land Use and Building Committees in Maryland, 1938-39. Mimeographed report, October, 1938.

696 Coddington. J. W. Revised Organization Plan for Agricultural Land Use and Program Building Committees for Maryland. Mimeographed report, October, 1938.

697 Coddington, J. W. Excerpt of Work-Outline for Agricultural Land Use and Program Building Committees in Maryland, 1938-39. Mimeographed report, November, 1938.

698 Burdette, Roger. Economic Status of Maryland Bee Culture. Proc. Md. Beekeepers Assn. January, 1939.

699 DeVault, S. H. Marketing Surveys, How They Are Made, What They Tell. Proc. Md. State Poultry Council, 1938-39.

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701 DeVault, S. H. and Cron, L. E. Some Results of the Baltimore Egg Marketing Study. The 1939 Maryland Poultry Yearbook. Md. State Poultry Council.

702 DeVault, S. H. and Burdette, Roger. The Baltimore Wholesale Fruit and Vegetable Markets. Proc. Md. Vegetable Growers Assn. January, 1939.

703 Poffenberger, P. R. Some Economic Aspects of Chick Purchases by Maryland Poultrymen. Proc. Md. State Poultry Council 1938-39.

704 Poffenberger, P. R. Source and Quality of Chicks Purchased by Maryland Poultrymen. The 1939 Maryland Poultry Yearbook. Md. State Poultry Council.

	FEDERAL FUNDS				STATE FUNDS*	OTHER FUNDS*
	Hatch	Adams	Purnell	Bankhead-Jones		
DR.						
To Balance June 30, 1938					$ 24,149.57	$ 5,239.91
Appropriations 1938-39	$15,000.00	$15,000.00	$60,000.00	$24,981.67	91,642.62	
Fees, Sales, Endowments and Fellowships						44,329.44
	$15,000.00	$15,000.00	$60,000.00	$24,981.67	$115,792.19	$49,569.35
CR.						
By Salaries	$10,656.42	$13,712.41	$43,803.97	$17,017.59	$ 39,562.99	$ 4,969.37
Labor	2,181.05		2,290.92	2,495.39	13,496.03	13,705.59
Stationery and Office Supplies	38.70	89.51	311.60	245.15	529.10	107.28
Scientific Consumable	131.08	99.47	1,473.14	666.25	906.07	42.38
Feeding Stuffs	936.50		187.54	330.49	5,415.56	8,670.25
Fertilizers	92.49		367.24	131.61	791.18	767.80
Sundry	166.67	29.33	742.51	447.15	1,701.64	617.29
Communication Service	137.78	68.95	125.50		844.23	97.35
Travel	14.90		2,067.01	357.55	3,586.22	637.84
Transportation of Things	249.31	1.30	91.69	127.50	1,194.77	588.49
Publications	.40		1,281.33	56.46	2,057.91	8.66
Heat, Light, Water, Power	106.93		11.65	175.89	340.02	268.83
Retirement					8,369.00	
Contingent	55.72				431.11	216.39
Furniture, Furnishings, Fixtures			713.34	92.70	650.36	356.90
Library			28.36	1.68	400.26	30.00
Scientific Equipment		909.57	2,686.73	1,195.62	438.82	488.14
Tools, Machinery and Appliances	171.79	89.46	1,681.20	536.90	4,537.49	374.09
Livestock	4.00		77.55	130.75	401.60	7,286.52
Buildings and Land	56.26		2,058.72	972.99	3,390.54	252.77
	$15,000.00	$15,000.00	$60,000.00	$24,981.67	$ 89,044.90	$39,485.94
Credit Balance June 30, 1939					26,747.29	10,083.41
Totals	$15,000.00	$15,000.00	$60,000.00	$24,981.67	$115,792.19	$49,569.35

*Including Bankhead-Jones Offset Funds.

REPORTS ON STATION PROJECTS

The Annual Report of the Station is an account of the activities of its staff members and of the progress made during the year. In many of the reports on projects, farmers and others will find valuable information on studies not sufficiently advanced for final publication. All of the studies have a direct bearing upon the commodity interests of one or more of the agricultural groups of the State. As in previous years the public is invited to take a personal interest in the research and experiments that interest them especially, and to become personally acquainted with the workers in the various subject matter groups.

AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

Work was accomplished during the year on twelve Experiment Station projects and on three cooperative projects with Federal agencies. Some of the accomplishments and significant contributions in research conducted under the respective projects are presented below.

FARM ORGANIZATION AND MANAGEMENT

Organization and Business Analysis of Maryland Farms—An Economic Study of the Broiler Industry in Maryland.—The results of the two-year study of the broiler industry were published in Bulletin No. 410. A brief analysis of the results of the study was presented in the annual report for the fiscal year, 1937-38.

An Economic Study and Analysis of Dairy Farms in the Philadelphia Milk Shed.—The records for the second and concluding year of the study of 180 dairy farms in the Upper Eastern Shore area were completed. The average acreage per farm was 237.1, of which 132.4 acres were in crops, 43.6 in pasture, and 61.1 acres in other land. The average number of cows per farm was 17.5; production averaged 4,880 pounds of milk per cow. Farm receipts averaged $5,260; farm expenses were $3,449; leaving a farm income of $1,811 and a labor income of $942. The major factors affecting profits were milk production per cow, total number of cows, yield of crops and the use of labor. An analysis was made of the tenant farms, most of which were on a one-half share basis for crops with the tenant owning the livestock and receiving the receipts therefrom. To remedy this inequality, a cash-share-crop lease is recommended.

An Economic Study of the Bee Industry: Management, Production and Marketing Practices and Problems.—Data relating to management, production and marketing practices were collected from 182 beekeepers in Maryland. These data have been tabulated and analyzed. This study shows that there are 2,775 farmers and 1,974 non-farmers in Maryland who keep bees. The number of colonies per beekeeper varies from one to over 100 and the average is 6.5 colonies. The average production per colony is 30.5 pounds of honey. The following items affect the production per colony materially: (1) methods of wintering; (2) time of adding and removing supers; (3) types of honey produced; and (4) number of colonies per beekeeper. Although the average net profits from the bee industry are rather small, it is an important source of income to many people. It is an enterprise that fits well into the farm labor schedule. It also affords income to other groups such as carpenters, bricklayers, miners and fishermen during periods of light employment. The income received from beekeeping often prevents many families' budgets from showing a deficit. A large percentage of the honey produced on the Eastern Shore is extracted honey that is sold to bottlers, wholesalers and city consumers. Most of the honey sold to city consumers in this area is marketed by parcel post. In Western Maryland, most of the honey produced is comb honey. Most of the honey produced is either used at home or sold to local consumers.

An Economic Study of the Hatchery Industry in Maryland.— The results of a study of 110 hatcheries in Maryland for a two-year period, July 1, 1936, to June 1, 1938, have been published in Experiment Station Bulletin No. 426. The hatcheries included in this study for the year 1937-38 incubated 1,437,632 dozens of eggs. Maryland hatcherymen purchased from Maryland poultrymen 58 per cent of the total number of eggs used at an average price of 31.2 cents per dozen, and they purchased from out-of-state poultrymen 42 per cent of the total eggs incubated at a price of 38.5 cents per dozen. The hatchery investment averaged $5,285 per hatchery, or $5.02 per 100 chicks hatched. Gross income from the hatchery industry averaged $8,961 per hatchery, or $8.81 per 100 chicks hatched. Cost of producing day-old baby chicks averaged $7,073 per hatchery, or $6.97 per 100 chicks hatched. Cost of eggs accounted for 63.7 per cent of the total cost; hatchery overhead, 10.3 per cent; labor, 9.7 per cent; selling cost, 4.4 per cent; allowances, 4.1 per cent; general expenses, 3.2 per cent; cost of containers, 1.9 per cent; cost of custom hatching, 1.9 per cent; and cost of breed improvement, 0.8 per cent of the total cost. The profit of the hatchery industry for the two-year period averaged $1.84 per 100 chicks hatched. This study reveals that those hatcheries which realized an average net profit of $2.00 or more per 100 chicks hatched had an average fuel cost of $2.91 per 1,000 chicks hatched; an average labor cost of $7.64 per 1,000 chicks hatched; an average selling cost of $2.11 per 1,000 chicks sold. Hatchability of eggs averaged 72.6 per cent. About 151,704 chicks were hatched per hatchery, and the hatchery capacity was utilized 3.1 times during the year. For the two-year period covered in this study about 59.3 per cent of Maryland poultrymen bought their chicks direct from Maryland hatcherymen, and 40.7 per cent bought chicks from hatcherymen in other states. The average price paid by Maryland poultrymen for chicks purchased from Maryland hatcherymen was $9.46, and for chicks purchased outside of the state, $10.51 per 100 chicks. Mortality of the chicks purchased from these two sources was 11.2 per cent and 14.9 per cent, respectively. Pullorum-tested chicks were purchased at $9.92, and non-pullorum-tested chicks at $9.39 per 100 chicks. Mortality of the chicks purchased from these two sources was 12.3 per cent and 16.9 per cent respectively.

An Economic Study of the Potato Enterprise in Garrett County.—During the last fiscal year, the second year's records were obtained on 103 farms in Garrett County. The work done in 1938-1939, covering the 1937 crop, included: an analysis of the farm in general, cost of producing potatoes, and the marketing of Garrett County potatoes. The study made in 1938-1939 was based upon 103 farm records and 55 records from agents handling Garrett County potatoes. The average farm family labor income on 103 farms included in the farm analysis section was $364 for 1937. More than one-half of the receipts was from the sale of livestock and livestock products. Potato yields were 183 bushels per acre in 1937, as compared with 237 bushels per acre in 1936. Cost of production for 1937 was $88.27 per acre, or $0.485 per bushel. Total income per acre was $107.38, or $0.59 per bushel. Net gain was $19.11 per acre, or $0.105 per bushel. The farmer's marketing cost was approximately 6 cents per bushel. Forty-two per cent of the total sales were at the farm to local buyers, and about 26 per cent of all potatoes were sold in Clarksburg, West Virginia. Independent retailers bought about 17 per cent of their potatoes from Garrett County, while produce wholesalers and chain store produce buyers purchased about 9 per cent of their potatoes from Garrett County. The trend seems to be toward fewer purchases of Garrett County potatoes.

Types of Farming and Agricultural Adjustments in Maryland.—This study, which was inaugurated in June, 1937, is a joint project of the Maryland Agricultural Experiment Station and the Division of Farm Management and Costs, Bureau of Agricultural Economics, U. S. Department of Agriculture. The objectives are: (1) to portray in a general way the agriculture in the State by showing the kind and proportion of crops and livestock produced; (2) to delineate areas within which certain combinations of crops and livestock predominate; and to show how the predominant types of farm organization in each area are related to the conditions existing in the area. During the year, two maps showing the soil series and the relative productivity of Maryland soils were prepared and printed in color. Much interest has been exhibited in the maps, since no other state has made such maps. The work maps and most of the text for the bulletin have been prepared for publication; however, much delay has been caused by the failure of the cooperating agency to complete its phase of the work, namely, the making of the final copies of the maps, in black and white, suitable for photographing.

LAND ECONOMICS

An Economic Study of Land Utilization in the Tobacco Area of Southern Maryland.—Most of the work under this project during the past year consisted of revising, refining, and improving the original manuscript preparatory for publishing as a bulletin (see Bulletin No. 424). The objectives of this study were: (1) to determine what effect changes and trends in the number of farms, in type of farming, and in population, have on land use in Southern Maryland; (2) to relate such changes to shifts in farm income opportunities; (3) to analyze the pattern of land use and its relation to basic physical factors; (4) to examine in detail a group of representative farms as a basis for farm practices in terms of soil conservation, farm returns, and adequacy of food and feed production; and (5) to formulate and recommend the basis for a program looking toward changes in land use and systems of farming which seem necessary and desirable. Some of the important conclusions include the following: (1) the use of crop land should be changed to provide for greater diversification of farming and, consequently, a minimum amount of idle land; (2) more of the feed and food required on the farm should be produced there rather than purchased; (3) more livestock should be kept on farms in Southern Maryland; (4) submarginal agricultural land should be diverted from farming to uses for which it is better adapted, such as forestry recreation or other purposes; (5) more emphasis should be placed on preventing excessive erosion; (6) a dual system of crop rotation should be promoted for tobacco farms which will permit land adapted for tobacco production to be used largely for that crop, and land not adapted for tobacco production to be used in the second crop rotation. The great need in Southern Maryland is to make proper use of the vast acreage of idle farm land.

A Sociological and Cultural Survey of Farms in the Tobacco Area of Southern Maryland.—J. W. Coddington cooperated with other members of the Bureau of Agricultural Economics in a supplementary study to the above-mentioned project in which an attempt was made to discover the relations, if any, between the economic factors revealed in the first study and such sociological factors as life histories, attitudes and opinions, standards of living, and social participation of farm operators and their families. Records were obtained from 120 of the 160 farms studied in the first project. An analysis of the data indicated that there was no material difference in size of families between the low and the high idle land groups, nor was there any significant difference in age of farm operators. The level of living of farm families in the low idle land group seemed to be somewhat higher than for those in the high idle land group. Farmers in Southern Maryland do not move as often as many people have been led to believe. Almost half of the farmers contacted had not moved more than once since engaging in farming. The farmers and their families in the low idle land group had a slightly higher education than those in the high idle land group. On the other hand, farm families in the high idle land group participated to a greater extent in social activities. More of the operators in the low idle land group of farms had climbed the agricultural ladder. The results of this supplementary investigation have been published in the quarterly publication entitled "Farm Population and Rural Life Activities," issued by the Bureau of Agricultural Economics, January, 1939.

An Economic Study of the Maple Products Industry in Garrett County, With Particular Reference to Land Use.—This study was inaugurated during the past fiscal year. It is a joint project between the Maryland Agricultural Experiment Station and the Bureau of Agricultural Economics. There are approximately 130 producers of maple products in Garrett County, and all of these producers were interviewed. A history of the maple products industry in the United States, and more particularly in Maryland, has been prepared. The general trend of production since 1850 has been studied. Results of the study show that a tree must be approximately 75 years of age before it is of producing size. Most Garrett County groves are between 175 and 225 years of age. Production data are now being studied to ascertain cost of production, grades of syrup produced and prices received. This information is being broken down on the basis of profitable and unprofitable groves, by management practices and by size of groves. A study is being made of the land use aspects of the industry in an effort to determine the place of maple products production in Garrett County farming and the advisability of recommending plantings of trees for future use.

A Study of Hillculture Opportunities in the Tobacco Area of Southern Maryland.—Members of the staff have cooperated with the Soil Conservation Service in the development of a project, and detailed plans for a study which aims at securing information and data which will serve as a basis for practical suggestions on specific hillculture possibilities in a well-rounded land use program for Southern Maryland. On almost every farm in Southern Maryland, there is some land which is not adapted for the production of farm crops. Much of this land could be used for the production of hillculture crops which would provide a supplementary income for farmers in the area. The provision of a supplemental source of income would help to reduce the hazards associated with one-crop farming. The production of hillculture crops on farms in the tobacco area of Southern Maryland may also provide for more uniform distribution of labor throughout the year than prevails under the present highly specialized system. It is contemplated that work on this project will begin about June 1st and continue throughout the summer months.

Other Land Use Planning Work.—On July 8, 1939, an agreement was established between the Land Grant Colleges and the U. S. Department of Agriculture, pointing toward the development of sound land use plans, programs and policies, for the purpose of correlating current action programs to achieve stability of farm income and farm resources. Kent County, Maryland, was selected as the county in which the unified agricultural program would be developed on an experimental basis. Under this program it is desired to encourage farmer participation in planning and developing agricultural programs in cooperation with the state experiment station and the various Federal agricultural agencies; to work out needed land use adjustments and changes in farming systems, practices, and institutions which will alleviate problems existing in the county; and to revise and coordinate the several agricultural programs so as to more rapidly improve agricultural conditions. Five counties were selected for intensive work, namely, Allegany, Howard, St. Mary's, Queen Anne's, and Wicomico. In these counties a detailed study is being made of county land resources including delineation of land use areas and defining agricultural problems, as well as the determination of desirable adjustments to promote more desirable land use, together with the formation of an agricultural program.

FARM TAXATION AND FINANCE

The Farm Tax Problem in Maryland—Research in Highway Finance.—A preliminary report of the Maryland Highway Planning Survey, issued in February, 1939, presents in summary form, the major part of the research project in highway taxation, conducted by the Maryland State Roads Commission in cooperation with the U. S. Bureau of Public Roads and the Department of Agricultural Economics, University of Maryland. This report analyzes and discusses data compiled on the following aspects of highway finance: (1) revenues and expenditures of units of government, with special application to highways, for the fiscal year ending in 1936; (2) highway user taxes contributed by motor vehicle owners, classified by types of vehicles and residence of owners; (3) usage made of highways by motor vehicle owners, as compared with highway user tax contribution by such owners; life history, life expectancy and cost of different types of state roads. Financial statements of the 151 governmental units or agencies were analyzed by accountants. Such analysis was designed to produce uniform, as well as accurate, information regarding the financial transactions of governments having so many different accounting and reporting systems. Particular emphasis was placed upon sources and purposes of highway expenditures, but other functions of government were also included. About 64,000 motor vehicle questionnaires, representing 17.5 per cent of the total registered motor vehicles in Maryland, were filled in by owners of motor vehicles. These questionnaires asked for the following information: place of resident owner, total miles traveled during the year 1937, miles traveled in Maryland during that year, average miles obtained per gallon of gasoline. From these data, an analysis was made of the highway user tax contribution and miles traveled by different resident groups of motorists owning the several classes of motor vehicles. In addition, an analysis was made of all the 377,000 motor vehicles registered in Maryland, to determine the exact residence of owners in counties and incorporated towns. From this tabulation, an analysis of the license fees paid by rural and urban groups was made, as well as a study of the year-model distribution. Personal interviews were made with 10,500 Maryland motor vehicle owners, and a questionnaire as to the travel characteristics of the owner for one year was completed. These data were analyzed to determine the use made of different highway systems and the highway user tax contribution of the several population groups. Each section of the state highway system, and each contract awarded for state highway construction, was analyzed for the following information in general: history of improvement made on each mile of state roads; retirement of classes of pavements; and, costs of construction.

These data serve the purpose of predicting the life expectancy of different pavements, and the probable cost of highway replacements and improvements for the future. Most of the data compiled in this survey, except the financial statements of the governmental units, were tabulated with the aid of punching, sorting and tabulating machines. The report referred to above contains discussion, charts and summary tables in the text, with 29 detailed tables on highway finance in the appendix. More complete analysis and interpretation of the data compiled in the survey is expected to follow in the near future.

Farm Taxation.—Data have been compiled and analyzed on several phases of farm taxation, principally the following:

> Total farm property assessments, by election districts, in 14 counties. Such farm assessments are broken down to show the assessments on buildings and land separate, and to show the practice of land classification for assessment purposes. These total assessments of land and buildings in the various election districts will be compared with farm census values of 1935.
>
> Detailed study of Kent County farm land assessments to determine assessment practices in relation to productive capacity of soil, yield of crops and kind of road.
>
> Comparison of farm sales and farm assessment values in seven counties, with special emphasis upon the degree of inequality among individual assessments, as measured by the coefficient of dispersion.
>
> Irregularity of farm property taxation, measured by the relationship between farm income, capital investment and property tax levies. This analysis compares the two types of farming, namely, poultry and dairy farming for three years, 1931-33, in respect to the above tax burdens, as well as livestock and broiler farming for the two years 1935-36.

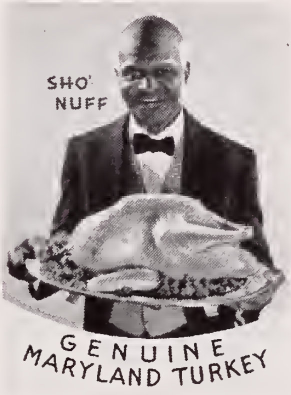
The purposes of the above analysis are: to measure inequalities in farm taxation in a broader way than the sales-to-assessment-ratio-system customarily used; to construct some basis by which farm property assessment inequalities can be more readily determined in the future; to lay the groundwork for improvements in farm property assessments by the use of better standards and methods. (The changes made in individual property assessments and district assessments, shown to be improperly assessed, can be observed after future reassessments are made.)

Research in State Revenues and Taxation.—S. H. DeVault and Wm. Paul Walker were members of Governor O'Conor's Revenue Committee. Considerable data were compiled in the preparation of the report of this Committee, as well as for official use during the 1939 session of the General Assembly of Maryland. These data concern the comparison of Maryland's tax system with tax systems of other states, and the possible yields of different sources of revenue. Sufficient data have been compiled to compare the state taxing system and revenue possibilities of Maryland with about twelve other states similar to Maryland in economic and social characteristics. Additional facts will make the study complete enough to justify analysis and preparation of a report on "The Revenue Possibility of the State Government of Maryland." Such a report would include a history of taxing measures utilized by this State, and the dependability, equity and economy of such revenues.

MARKETING

The Marketing of Eggs in Maryland, With Special Reference to the Baltimore Market.—The egg marketing survey begun in 1937 was continued in 1938. Data relating to the marketing of eggs in Maryland were collected from wholesalers, commissionmen, jobbers, meat packers, retail stores and consumers in Baltimore. The results of this study show that wholesalers, jobbers, commissionmen and other wholesale dealers in Baltimore receive 334,777 cases of eggs annually, that 66.5 per cent arrive by truck, 29.4 per cent, by rail; and 4.1 per cent, by boat. These eggs are received from the following sources: wholesalers, 27.2 per cent; country stores, 4.5 per cent; hucksters, 36.2 per cent; cooperatives, 7.3 per cent; country shippers, 10.9 per cent; and farmers, 13.9 per cent. A study of retail stores shows that retailers in Baltimore purchase their eggs from the following sources: wholesalers and jobbers in Baltimore, 48.7 per cent; farmers, 25.1 per cent; meat packers, 12.6 per cent; hucksters, 10.0 per cent; commissionmen, 2.6 per cent; and others, 1.0 per cent. Cold storage eggs constitute 22.0 per cent and fresh eggs, 78.0 per cent of the eggs sold at retail stores in Baltimore. A survey of 1,075 representative Baltimore families was made to determine consumer preference. Monthly trips were made to 50 grocery stores to collect information on the price and quality of eggs offered for sale during the year. The results of the study show that a great deal of educational work needs to be done to acquaint both producers and dealers with better methods of handling eggs. In addition, much could be done to promote a better understanding of egg quality among consumers.

Marketing Maryland Turkeys.—During the last fiscal year, a study was made of 191 turkey flocks in Maryland; also, information was obtained from 27 agencies in Baltimore City which handled large quantities of turkeys for the production season of 1937-38. Turkeys were sold by five principal methods. Of the total number of birds sold by Maryland producers, about 49 per cent were sold alive on the farm; 20 per cent, alive on the city markets; about 4 per cent, sold dressed on the farm; 11 per cent, sold dressed at wholesale; and 15 per cent, sold dressed at retail. The average price received for turkeys was 24.6 cents, 26 cents, 32.8 cents, 31.2 cents and 33.4 cents per pound by the respective methods of sale. For the year 1937-1938, 11.7 per cent of Maryland turkeys were marketed in October, 39.2 per cent in November, 44.5 per cent in December, 2.3 per cent in January, 0.9 per cent in February, and 1.5 per cent in the other months of the year. Turkeys were sold through the following outlets: direct to consumer, 21 per cent; to local buyers, 43 per cent; to commission merchants, 25.1 per cent; to hotels and restaurants, 1.1 per cent; to retailers, 6.3 per cent; to dressers, 2.7 per cent; and to others, 0.8 per cent. In Maryland, 28 per cent of the turkeys were delivered by automobile, 57.7 per cent by truck, 6.8 per cent by parcel post, and the remainder was delivered by express and freight. It was determined that of the total Baltimore City live turkey receipts, Maryland turkeys made up only about 27 per cent; and of the total dressed turkey receipts, Maryland turkeys accounted for less than 1 per cent. Commission merchants, meat packers, killing plants, and chain stores play an important part in handling turkeys in Baltimore City. General information was obtained relative to size of turkeys demanded by the consumer, the attitude of producers toward cooperative marketing of turkeys, seasonal marketing, the possibility of an Eastern turkey market, and the possibilities of marketing turkeys as broilers.



Registered Trade Mark of the Maryland Turkey Producers' Association.

The Effect of Motor Truck Transportation of Products Upon the Marketing Facilities of Baltimore.—Although the results of this study were published in Bulletin No. 409, by the Maryland Agricultural Experiment Station in May, 1937, additional data were collected on the cost of constructing a new consolidated wholesale fruit and vegetable market in Baltimore. Several sites were surveyed to determine their advantages and disadvantages for a market, and the probable cost of a new market at each site was estimated. The information obtained in this study was used by the Agricultural Committee of the General Assembly of Maryland at the last session of the Legislature in drafting a bill providing for a marketing authority to study the situation and to make such changes in the markets of Baltimore as are deemed advisable.

Status and Trends of Agricultural Cooperation in Maryland.—The study entitled "The Status and Trends of Agricultural Cooperation in Maryland, 1930-36," conducted during the years 1936-37 and 1937-38, is now in the process of revision for publication. It is intended that the data for 1937 and 1938 will be collected and added to the study in order to bring it as nearly up to date as possible before the final draft is prepared. The study should be completed and published sometime prior to January 1, 1940.

A Detailed Study of the Operation, Policies and Membership Relations of the Maryland Tobacco Growers' Association.—The principal research work in agricultural cooperation in Maryland carried on during the past year consisted of a membership-relations study of the Maryland Tobacco Growers' Association, begun July 7, 1938, and now nearing completion. In the spring of 1938, the Board of Directors of the Maryland Tobacco Growers' Association indicated to the officers of the Baltimore Bank for Cooperatives that a study of the Association's membership relations was needed. Subsequently, the request for such a study was submitted to the Agricultural Economics Department of the University of Maryland and to the Research, Service, and Education Staff of the Cooperative Division of the Farm Credit Administration in Washington, D. C. Arrangements were worked out whereby these two agencies jointly would conduct this study for the requesting cooperative under the supervision of Mr. John J. Scanlan of the Farm Credit Administration, with Mr. J. Russell Ives of the University of Maryland doing the field work and later supervising the tabulation of the data collected. During the summer and fall of 1938, 261 tobacco growers in Maryland were interviewed and their personal opinions obtained on such topics as: reasons for joining the Association; benefits received from Association; criticism of methods of operation of the Association, its personnel, its officers, etc.; suggestions for improving the Association; suggestions for improving the system of marketing of tobacco; opinions toward recently proposed changes in the marketing system; that is, loose-leaf floor, etc. Two hundred of the growers interviewed are current members of the Association, while the remaining 61 have never joined or have withdrawn from the organization for one reason or another. Due to the great number of topics covered in this study (nearly 150 separate questions were included) and the limited personnel employed on it, considerably more time is being required for its completion than was originally anticipated. Because of the nature of this study and of some of the very personal topics covered, it is likely that a summary report only will be prepared for public distribution.

AGRICULTURAL ENGINEERING

Grain Storage on the Farm.—Besides the regular observations on wheat in storage bins the development of the new type of grain drier was continued. A large unit of the machine was constructed on a semi-trailer so that it can be moved from farm to farm for drying purposes. Approximately 1500 bushels of wheat produced on the University farm, and harvested by combine, were dried in the new machine. Some of this wheat was harvested soon after a heavy rain and was so wet it was necessary to pass it through the machine twice to reduce the moisture sufficiently for keeping. A summary of the tests shows the results of this work. Grade determinations were made by Mr. Harold Anderson, Federal Grain Supervisor of Baltimore, Maryland. It will be noted that many of the samples turned sour in shipment which indicates that such grain requires immediate drying to prevent spoilage. The effectiveness of the process is shown by the data. The drier was also taken to two farms for drying work to determine the ease of setting up for operation under farm conditions.

The effect of the drying on germination has not been determined as yet, but determinations will be made. This factor should have no influence on the milling quality of the wheat. One lot of 12 per cent wheat was dried to below 10 per cent moisture. While this is in general uneconomical, and also unnecessary for ordinary storage, it indicates the possibilities of the machine. Approximately 300 bushels of wheat harvested by combine soon after a rain were dried to an average moisture content of 13.7 per cent from an initial moisture content ranging from 21 to 26 per cent. It was necessary to pass this wheat through the machine twice in order to dry it, as it was impossible to slow the machine down sufficiently with the present drive to complete the process by passing it through once.

Test Number	1	2	3	4	6	7	8	9	10
Date	6–23	6–23	6–27	6–27	7–1	7–1	7–3	7–3	7–7
Initial moisture	18.9	19.5	12.3	13.1	24.8	25.2	24.2	18.5	19.7
Final moisture	11.9	15.4	10.8	11.1	17.9	20.8	16.4	14.0	14.0
Moisture reduction	7.0	4.1	1.5	2.0	6.9	4.4	7.8	4.5	5.7
Rate, bu./hr.	24	40	52	60	24	36	24	40	36
Water removed, lbs./hr.	124	122	53	83	132	127	148	132	153
Odor, initial	Nat.	Nat.	Nat.	Nat.	Sour*	Sour*	Sour*	Sour*	Sour*
Odor, final	Nat.	Nat.	Nat.	Nat.	Nat.	Musty*	Nat.	Nat.	Nat.
Damage, initial	2.5	2.4	0.5	0.5	3.5	7.5	6.8	4.5	3.5
Damage, final	2.4	2.4	0.5	0.5	3.5	7.3	6.5	4.5	3.5
Wt./Bu., initial	55.0	54.5	59.0	59.0	47.5	48.0	48.7	54.2	51.3
Wt./Bu., final	57.7	56.8	58.3	58.4	52.0	50.5	53.0	56.8	54.6
Initial grade	Sg, Rw Gar	Sg, Rw Gar	2 Rw Gar	2 Rw Gar	Sg, Rw Gar	Sg, Rw Gar	Sg, Rw Gar	Sg, Rw Gar	Sg, Rw Gar
Final grade	3 Rw Gar	3 Rw Tough Gar	2 Rw Gar	2 Rw Gar	Sg, Rw Gar	Sg, Rw Gar	Sg, Rw Gar	3 Rw Gar	4 Rw Gar
Approximate bu. in test	150	150	100	100	120	200	100	240	350

*Sour or musty odors developed in sample during shipment.
Sg—Sample grade. Rw—Red winter. Gar—Garlicky. Nat.—Natural.

Electric Milk Pasteurizer Investigations.—The electric milk pasteurizer work was largely on two phases, that of uniformity of temperature throughout the mass, and that of temperature control at the cut-off point. Proper agitation with a large, low speed agitator provided uniform temperature throughout the mass. Temperature control at the cut-off point provides several unique problems. There is no over-run in the Batch type pasteurizer after the current is cut off, as there is no stored heat in any part of the container or heating unit. Thus, thermostatic controls can be set at the desired temperature without any after heating allowance. The heating curve for the electric pasteurizer is opposite to that of the steam or hot water pasteurizers. In the latter, the rate of temperature rise decreases as the pasteurizing temperature is approached due to a decrease in the temperature differential between the milk and the heating medium. In the electric pasteurizer heating is slow at low temperatures and the rate of temperature rise increases with the temperature due to a drop in the electrical resistance of the milk. The temperature rise is approximately 5° F. per minute in the present model. Sensitive control equipment is thus required to provide satisfactory operation. This factor should, however, help prevent cream line reduction by reducing the time during which milk is held near pasteurizing temperature.

AGRONOMY

Corn—Variety Tests and Selections.—Most of the varieties carried in this project in the past have been put in the tests for hybrid corn. No selection in open-pollinated corn was being practiced in 1938.

Wheat.—The wheat variety comparison was continued much in the same manner as in the past. Because of wet weather throughout October of 1937, the plot land could not be seeded until November 8th. As a result, a poor stand was obtained on those plots which were located on low, poorly drained areas in the field. Some whole plots and parts of others had to be discarded. Surviving plants were severely attacked by leaf rust. Although yield comparisons were not valid, other records on response were obtained.

Barley.—The barley trials in 1938 were handicapped by late planting on wet land. Because of the resulting poor stand it was necessary to discard one plot series completely. However, plantings which preceded the heavy October rains of 1937 came through satisfactorily. Work in the nursery was continued to be directed toward the selection of winter-hardy and disease resistant smooth awn strains. A seed lot of several bushels of

Marnobarb from a field which showed about eight per cent infection with loose smut was given the hot water treatment prior to planting in the fall of 1938. The resulting crop was satisfactory as to stand, and only three-tenths of one per cent of the heads were smutty. Untreated seed, on the other hand, showed about the same amount of infection, as did the previous crop.

Sweet Corn Seed Production and Breeding.—In 1938 this project continued to have two divisions of activity, namely, the field comparison in replicated plots of commercial and experimental hybrids, and the production of new crosses from inbred lines bred and selected locally. The results of field comparisons were reported in Miscellaneous Publication No. 682. The latter includes data and discussion of results for one hundred varieties and hybrids grown at College Park and sixteen grown at Ridgely, Maryland. The best tonnage in the whole test was made by three white crosses involving a Maryland Station inbred. Canning tests made on these crosses showed them acceptable as to quality. If 1939 tests bear out former tests one or more of these crosses will be ready for commercial trial. In the nursery numerous crosses were made among inbred lines developed at this Station, the purpose being to find lines which combine to produce pro-

Lodged corn plant, due to heavy infection of stalk-rot, Diplodia zeae.

ductive hybrids of acceptable quality. There is considerable demand for good white hybrids and for yellow hybrids larger and later than Golden Cross Bantam. The material on hand gives promise of filling these demands.

Development of Dent Corn Hybrids Specifically Adapted to the Corn Growing Areas of Maryland.—In 1938 seven local varieties and sixty-three hybrids were included in trials at one or more places. Two tests (College Park and Ridgely) were located on Sassafras, a Coastal Plain soil. The third was at Spencerville on Chester loam, one of the best soils for corn in the Piedmont area. In comparison with open-pollinated varieties, hybrids performed to better advantage at Ridgely and Spencerville than at College Park. From forty-five hybrids tested at all three locations, six out-yielded the best variety in each test. Thus there is evidence that some existing hybrids will prove acceptable over a wide area in the State, while others will be restricted in adaptation. A majority of the most productive hybrids were of the prolific type, a type not very popular in the most productive corn-growing section of Maryland. In order that parental stocks established elsewhere may be supplemented by inbred lines from locally adapted varieties, a program of inbreeding was in effect in 1938 and will be continued in 1939. Special attention is being given to disease resistance in the lines being

View of corn on strip-cropping plots.

Hybrid corn tests. Note poor stands in block of inbred lines.

isolated. Results were published in Miscellaneous Publication No. 671. Also, a paper entitled "Hybrid Corn" which summarizes some of the results of practical interest, was published in the Report of the Maryland Crop Improvement Association for 1939.

Improvement of Permanent Pastures in the Several Soil Provinces of Maryland.—The field work on this project has consisted of continued yield comparisons from grazing and clipping of local selections against commercial stocks and pasture strains from elsewhere. Increase plots for seed production have been planted from some of the more promising strains of white clover, Kentucky bluegrass, perennial ryegrass, orchard grass and local black medic. A graduate student has conducted a study of the effect of closeness of clipping on top growth, root growth, and survival of two strains of bluegrass and one of ryegrass. These studies confirm earlier observations on the great difference among strains in vigor under close clipping.

Studies on the Reproductive Capacity of the su (Sugar) Factor in Relation to the Su (Starch) Factor in Corn.—No new planting was made in 1938 of this segregating corn population under the influence of natural selection. Because earlier studies of this data showed the progenies from yellow kernels to be regularly more vigorous than those from white kernels, a new cross was made in which the factor for white comes from an adapted field corn. The object of this new cross is to learn if the benefit of yellow results from some response from the gene itself or whether it results from a linkage association with other genes for vigor. Continued detailed studies of the accumulated data are throwing much light upon dominance of quantitative characters. A factor for general vigor has been located on the same chromosome with the starchy factor while one of the factors for ear number is estimated at about sixteen cross-over distances from the factor for endosperm color.

Isolation of Improved Selections of American Wormseed (Chenopodium ambrosiodes, Va. Anthelminticum L.).—This project was started in 1938 for the purpose of isolating selections of wormseed that are superior in oil production. The oil of the plant is contained in glandular hairs which are found in small numbers on the leaves and stems and in large numbers on the ovary of the flower. A comparison between the production from wormseed plants that have few of these oil glands on the under sides of the leaf and plants that have many, indicates that there is a rather close positive correlation between the number of glands on leaf and ovary. Therefore the leaf count is a useful index of oil-producing capacity. There is some indication that this increase in oil production is accompanied by an increase in the quality of the oil. The progenies from plants which had a relatively high number of oil glands on the under side of the leaf were found to have a higher mean number of oil glands and to produce more oil than the progenies from plants which had relatively low numbers of oil glands.

Hay, Forage and Pasture Crops.—Alfalfa strains from various sources have been tested for a number of years. The plots planted in 1938 were winter-killed, but were renewed during the summer of 1939. Tests on strains of fescue grasses are carried both for turf and forage studies. These plots were removed from their former location on the campus to the new Plant Research Farms. The rotation pasture experiment, as laid out originally, was intended to determine the possibility of extending the grazing period through a greater part of the summer. This phase of the work has been completed and results indicate that separate plantings of orchard grass, Kentucky bluegrass, redtop, white clover and lespedeza will provide increased grazing during the summer months when mixed pastures usually are unproductive due to low moisture conditions. It is expected that the project will be revived at a later time and animals will be used for measuring the results obtained. Fifteen strains of red clover from different sources were seeded in the spring of 1938 to compare them with local strains in relation to growth habits and yield. The strains from Maryland, Kentucky and Tennessee proved much superior to the other strains in the test. The following strains were used in the test: Illinois, Hungarian, Polish, Canadian, Kentucky, Tennessee, Maryland, Chilean, Central Corn Belt, Italian, Ohio, French and Roumanian. All of the foreign strains disappeared after the first year, and the growth of the first year was unsatisfactory. The strains from Ohio and the Central Corn Belt did better than the foreign strains but were not equal to the Maryland, Kentucky and Tennessee strains. Five annual varieties of lespedeza were seeded this spring to study their growth and seeding habits under Maryland conditions. Lespedeza sericea, a perennial, was seeded in mixtures with timothy, orchard grass and English ryegrass to study its possibilities in hay mixtures. The annual lespedezas were seeded with timothy, orchard grass, and English ryegrass to determine whether a crop of grass hay can be harvested in June and then the lespedeza and grass aftermath be utilized for pasture during July and August. Twenty-one of the most promising varieties of soybeans are being tested to study the characteristics of growth, date of maturity, and the yield of hay and beans. Twenty-four different varieties, most of them unnamed, are being tested under Maryland conditions. Most of these are supposed to be good for human consumption. Three varieties of grain sorghum were seeded to compare the yield with that of Reid's Yellow Dent corn. All three of the sorghums out-yielded the corn. The average yields were as follows: Western Blackhull, 35.35 bushels per acre; Pink Kafir, 36.41 bushels per acre; Hegari, 34.08 bushels per acre; and, Reid's Yellow Dent Corn, 29.95 bushels per acre. This test was conducted on very poor soil and it is doubtful if grain sorghum would out-yield corn on a better type of soil.

The Effect of Organic Matter on the Fertility of Leonardtown Loam.—The purpose of this project was to determine whether the organic matter content of the soil can be increased by the turning under of cover crops and crop residues and the production of crops still be maintained. The rotation was tomatoes and barley, with a cover crop seeded in the barley and allowed to grow throughout the growing period of the year following the seeding of the barley. This was turned under the following spring for the tomato crop. The crops used were lespedeza, sweet clover and timothy. Ten tons of farm manure were added in the place of green manuring crops on some of the plots. Five years' results in yield have indicated that sweet clover and farm manure were far superior to the other sources of organic matter. Due to the change in the plans of the campus it was necessary to discontinue these plots with the fall crop in 1938. All the plots were carefully sampled at that time. On these samples, determinations of the total exchange capacity, the inorganic exchange capacity, the total carbon content, the exchangeable calcium, magnesium, potassium and manganese are being determined. The work will be completed, and the final report will become available at an early date.

Field Studies of The Fertility Requirements and Management of Important Soil Types.—Only two fields are in operation under this project at the present time. They are: Princess Anne and Ridgely.

Princess Anne: The yields on the Princess Anne field have continued to be satisfactory. The low amount of organic matter contained in this soil and the low natural fertility indicate that the growing crops are not able to obtain enough plant food for maximum crops without a rather high rate of fertilization. Although the plots do not adapt themselves to such a study it would be very beneficial to observe the effect of increasing the organic matter and base content of the soil on the fertility level.

Ridgely: The 1938 revision of fertility treatments on Section A have resulted in a noticeable increase in yields. Better results have been obtained which have been reflected in both quality and yield. This has been especially true of tomatoes. Although we have only one year's results the indications seem to be that this soil can be made to produce satisfactory crops if sufficient fertilizer is used. Previous to the present fertilizer program the yields had been unsatisfactory. Since these soils are similar in origin to those at Princess Anne the increases in yields are in line with those of Princess Anne when larger amounts of fertilizer are used.

Fertilizer Studies with Early Potatoes and Sweet Potatoes.—The potato fertilizer work which was started in 1932 on the Pilchard Farm near Pocomoke, Maryland, was revised following the 1938 crop. It was believed that six years' results should indicate the relative value of different fertilizer materials. These results indicate that in a normal season the source of nitrogen is insignificant, providing the acidity is properly controlled. The use of lime to neutralize the acidity formed by the breakdown of fertilizer material was much more satisfactory when it was mixed with the fertilizer, than when applied directly to the soil. Some of the plots on this farm were on lower land and contained much more organic matter than the plots forming the main part of the experiment. The results on the low land indicate that the use of fertilizer will be satisfactory only when there is not an excessive amount of moisture in the soil. The well-drained sandy loam and loam soils responded most favorably to the fertilizer except in cases where the rainfall was improperly distributed or insufficient.

Efficiency of Soil Fertility Management.—The study of the effect of farm practices on the fertility of the important soil series was continued. The trend during the past year has been very much the same as that obtained during the previous five years. The exchangeable bases data as well as the rapid tests indicate that on the majority of the farms the fertility levels are not being fully maintained. On many of these farms the higher analyses and increased amounts of fertilizer are now used. The trend shown by the results on these thirty-three farms is evidence that the tests on the soil, if continued for a sufficient time, are effective in determining the fertility requirements. The response of the farm owners to the soil needs is evidenced by the increased use of the experimental data.

The Effect of Fertilizer on Fertility and Grass Population of Pastures.—This is a study of the effect of rate of fertilizer application, kind of fertilizer, and time of application, on the yield and grass population of pastures. The soils are sampled by one inch depths in order to determine the downward movement of the phosphorus. This year's results are quite similar to those obtained during the previous four years. The fertilizer with the higher phosphoric acid content gave the most green material. The downward movement of phosphorus in most soils is very slow. On the fine-textured soils the greater penetration was secured from fall applications. There was a definite tendency on the College Park plots for the nitrogen to decrease the downward movement of the phosphorus. This probably was due to the fact that the nitrogen stimulated the top and root growth which caused an increase in the utilization in the upper levels. There was a similar trend on the Kelly farm plots (Montgomery County) but not as pronounced as on the College Park plots.

Fertilizer Formulae and Analyses for Late Potatoes.—This work continued very much in the same manner as during the past several years. It is the study of fertilizer ratios on the production of potatoes in Western Maryland. The results indicate that on soil in which there is considerable available phosphorus the use of a 4-8-8 fertilizer may be the most satisfactory. On soils high in organic material or on soils in which a good green manure crop has been turned under, the 3-12-6 fertilizer may be the most profitable.

The Study of Methods of Obtaining Total Exchange Capacity and Exchangeable Base Content of Soils.—This project is a comparison of several of the proposed methods for making total exchange capacity determinations in soils and the determination of the displaced cations. This work was continued from last year. Although the results are not quite complete the indications are that the ammonium ion which has been used in the past, and which is probably used more than any other salt to displace cations, is satisfactory for the displacement of calcium, magnesium and potassium. The total exchange capacity, as determined by the ammonium ion, is much lower than that obtained by other salts.

Soil conservation experiment on contour-strip crop farming project. Note rain gauge in foreground; surface flow measurement equipment in background.

Hydrologic Studies with Reference to Soil Moisture Conservation, Soil Fertility and Flood Control.—The purpose of this project is to determine the influence of water moving downward in the soil, as against runoff, on the fertility level of the soil, and the determination of the necessary measures for erosion and flood control, and moisture conservation in Maryland requiring protection. The field work consists of a three-year rotation in both strip cropping and diversion terraced areas. The laboratory studies will consist of determinations of the changes that take place in the nutritive elements and organic content of the soil. The work was started in June of 1937 and the first results will be obtained during the fiscal year 1939-40.

Rapid Soil Testing.—The demand for rapid soil testing has been heavy. Although the number of samples was not as large this year as in the previous year (about six thousand samples were tested last year), the number of farms represented was larger. The demand for tests to determine the need of boron has been unusual. Although some work has been done on this no satisfactory method has been evolved. Work on devising a method for the determination of its presence in the soil is under way. We have found cases in which our results have not completely indicated the proper amount and kind of fertilizer. This has been true largely from the potash and phosphorus standpoint. In order to make the tests more adaptable to these conditions, we have devised a more concentrated extracting solution. This seems to work on all of the soil tried so far. This new solution contains 25 per cent sodium acetate and 60 cc. of glacial acetic acid per liter. It is slightly more than twice as concentrated as the Universal solution. It can not be used for all tests since on many soils it will remove too much plant food. Although our technique in making rapid soil tests is more or less standardized it is probable that it will be necessary to revise it from time to time. The soil testing service has been used to greater extent than formerly by the commercial companies. They have sent in around 20 per cent of the samples tested. The county agents have sent in approximately 50 per cent of the samples tested.

ANIMAL AND DAIRY HUSBANDRY

Study of the Factors Which Involve the Production of Pork Products of Desirable Quality and Palatability.—This project, a continuation of the original project entitled, "Study of Quality of Maryland Hams," was started in 1927 and has been conducted by the University of Maryland in cooperation with the United States Department of Agriculture Bureau of Animal Industry. Studies relating to salt penetration in hams were continued on this project during the year 1938-39. This year's work was organized to include the aging phase in an endeavor to determine to what extent aging would result in the more equal distribution of salt throughout hams, and by what means such penetration was accomplished. Seventy paired hams were selected for this study. Two aging temperatures are used: 55° F., which represents the average yearly temperature for College Park, Maryland; and 107° F., the temperature adopted as standard in previous studies with incubator aged hams. Muscle sections secured from a cross-section ham slice, are analyzed at monthly intervals during aging following the technique used last year. At the end of 12 weeks and again at 20 weeks, two hams from each type of cure and from each aging temperature are cooked and tested for palatability in an effort to correlate these factors with actual salt and moisture determinations.

Gathering moisture loss and salt penetration data on brine-cured and dry-cured hams aging in a temperature regulated incubator held at an average temperature of 108° F.

Control of Contagious Abortion in the Experiment Station Dairy Herd.—This project is a continuation of the work reported in Station Bulletin No. 331, "Contagious Abortion in the Experiment Station Dairy Herd," published in February, 1932. Blood tests are taken at frequent intervals and a complete history of the breeding and calving record kept on each animal in the herd. Within the next year additional data on this project will be available to supplement those published in Bulletin No. 331, and to determine the number of abortions in a herd negative to the Bang's Disease Test.

Growth Data on Dairy Animals from Birth to Freshening Age.—In connection with this project, monthly weights are taken on all heifers raised from birth to freshening age in the University herd. The first results obtained in this study were reported in the Forty-Eighth Annual Report of the Station. It is planned to expand this project within the next year to include feed and cost data in addition to growth data on the heifers for the same period. The figures and results obtained in this study should be of much interest and value to Maryland dairymen who are raising or buying heifers for replacement purposes.

Input as Related to Output in Milk Production.—The second year of this feeding project will be completed this year. The principal results secured during the first year of the trial may be summarized as follows:

	Feed Consumption			Production		
	Grain lbs.	Hay lbs.	Silage lbs.	4% fat corrected milk (lbs.)	Per cent expected production	Profit above feed costs
Standard	1,571.5	3,498.0	10,469.0	6,636.7	113.3	$123.12
1 - 2	3,935.6	3,314.3	10.938.4	7,494.6	127.9	113.38
1 - 3	2,684.4	4,112.2	13,086.5	7,391.6	117.6	117.58
1 - 4	2,086.0	4,282.5	14,381.9	7,468.4	125.1	124.22
1 - 6	1,232.9	4,296.2	13,821.3	6,508.3	106.8	109.70
Roughage alone		5,946.9	12,869.9	5,628.6	91.6	92.08

This project is being extended for one more year to determine the point at which increased levels of feeding show diminishing returns. The final results secured in this feeding experiment should show the rate and method of feeding at which it will be most profitable to feed dairy cows.

The Value of Adding Kelp Meal to Rations of Dairy Animals.—This project has been under study for approximately two years using dairy heifers. The heifers were approximately one year of age when started on the feeding trial and were continued on the experiment until they freshened. Under the present plans the heifers will be continued on the trial throughout their first lactation period and until their second freshening. The purpose of this feeding experiment is to determine the value of and effect of adding dried kelp to the rations of dairy cows and heifers. Complete data as to breeding history, condition at calving, weight and condition of calf, growth development of heifer and production records will be secured on each animal for analysis at the completion of the project. Approximately 30 pairs of heifers will be used in the experiment.

Holstein Heifers that are being used in an experiment to determine the value of adding Kelp Meal to the rations of dairy cattle. A total of seventy heifers of the Guernsey, Ayrshire, Jersey, and Holstein breeds are now in this experiment.

Use of Annatto as a **Tracer in Cream.**—Annatto (cheese color) is recommended as a tracer for use in heavy cream. A method for the detection of annatto in heavy cream has been devised. This method involves the precipitation of proteins by alcohol, extraction of fat by gasoline, removal of serum and treatment with sodium hydroxide, filtration of serum and treatment of dried filter with stannous chloride. A pink color indicates the presence of annatto. This test is sensitive to one part in 400,000. A rapid test based on the principle of the long test has also been developed. This test involves the use of a centrifuge to remove the serum. It is recommended when annatto is present in concentrations far greater than one part in 400,000. It is less sensitive than the long test since time is not permitted for complete extraction of the annatto. Progress is being made on the standardization of annatto and on factors that may affect its destruction or decomposition. A local health department has adopted the use of annatto as a tracer in cream for manufacturing purposes based on the work done at this Station.

The Effect of Weather Variations on the Retail Sale of Ice Cream.—The purpose of this project, which was started in October, 1936, is to determine to what extent variable weather conditions affect the retail sale of ice cream. Daily record of prevailing weather conditions at College Park are being kept by the Maryland Station, operating under the U. S. Department of Agriculture Weather Bureau, in cooperation with the Maryland State Weather Service. These records include highest temperature in 24-hour period, lowest temperature in 24-hour period, the mean for 24-hour period, precipitation (rainfall and snowfall), character of day, whether cloudy or clear, and any miscellaneous phenomena. Records are also being kept of the daily sales of ice cream at the University of Maryland Dairy Salesroom. From the data obtained to date indications are that where there is a marked rise in temperature above normal there is also a definite increase in the sale of ice cream. If the above normal temperatures prevail for a period of five or six days there has been a gradual decrease in the sale of ice cream during the latter part of the period. The results obtained the first year do not warrant drawing definite conclusions at this time. It is planned to continue this study for another year during which time a recording thermometer will be used to record temperatures of each hour during the day.

Determining the Energy Values of Distillers' By-Products in the Rations of Beef Steers.—This project was started on December 9th, 1938 and continued until May 4th, 1939, when the steers were sold at Baltimore. The purpose of this experiment is to show the value of distillers' rye dried grains and distillers' rye whole slop in cattle fattening rations. Results indicate that distillers' rye dried grains can be used successfully to replace part of the grain in the ration as regards gains and cost of gains. Steers fed distillers' rye dried grains in combination with cane molasses and corn obtained a greater degree of finish than those fed corn alone, as determined by rib analyses. Steers fed distillers' rye dried grains in combination with corn, showed less finish than those fed corn alone, however. The substitution of distillers' rye whole slop for a part of the corn in the ration caused a marked decrease in the amount of finish. Four lots of ten steers each were used in the first year's test. This test will be repeated.

Beef steers in open sheds used in an experiment "To Determine the Energy Values of Distillers' By-Products in the Rations of Beef Steers."

The Feeding Value of Distillers' Rye Slop for Dairy Cows.—Considerable quantities of distillers' rye slop are available for feeding purposes to dairymen in Maryland. Many inquiries are made relative to the value of this product, yet its feeding value for dairy cattle does not appear to be known. While many dairy farmers in Maryland have fed distillers' slop with apparently good results, no feeding experiments have ever been conducted to determine its feeding value for dairy cows. Therefore, a feeding experiment with milking cows to determine the feeding value of distillers' slop was conducted at the Maryland Agricultural Experiment Station from January, 1939, to March, 1939. Twenty cows were included in the test. The cows were divided into two groups as equally as possible in all essential respects. A continuous system of feeding was followed. One group received alfalfa hay, corn silage, and a good concentrate mixture in sufficient amounts to meet the requirements of the Morrison Feeding Standards. The other group received the same ration except one-half of the dry matter in the concentrate or grain mixture was replaced by an equivalent amount of dry matter from distillers' rye slop. No significant difference in favor of either ration was observed. When the milk production of both groups was equated to an equal energy basis of 4.0 per cent fat, the ten cows receiving distillers' slop produced daily an average of 21.03 pounds of milk, and the cows receiving the normal ration produced daily an average of 20.11 pounds of milk. Such a difference appears to be entirely within the limits of experimental error. With a good concentrate mixture valued at $30.00 per ton, the value of distillers' slop was found to be $1.52 per ton. It took 19.68 pounds of distillers' slop to replace one pound of grain mixture. From these results it would seem that distillers' slop would be a desirable feed only for those dairymen situated near enough to distilleries to make it cheap to haul. The distillers' rye slop used in the experiment was obtained fresh each day from the distillery. The average composition of the distillers' slop obtained from weekly composite samples was as follows: water, 94.77 per cent; protein, 1.72 per cent; ash, .29 per cent; fat (ether-extract) .21 per cent; fiber, .44 per cent; nitrogen free extract, 2.57 per cent. Some difficulty was encountered in getting the cows to consume the slop at the beginning of the experiment. Its palatability was increased by the addition of approximately one-half pint of cane molasses per cow per day until the cows became accustomed to drinking it, and by feeding the slop in a warm condition. Best results were obtained when it was fed at a temperature of approximately 100° F. No difference in physical condition could be observed between the cows on this experiment, which could be attributed to the ration fed. Distillers' slop had no deleterious effects on the flavor and odor of the milk in this experiment. The slop was fed immediately after milking in all cases. There was no evidence that feeding distillers' slop would increase the incidence to mastitis.

A Small Electric Milk Pasteurizer.—The purpose of this study is the construction of a practical small electrical milk pasteurizer. In the present tests records are kept of current, voltage, power, heating time and temperatures at various points in the milk mass. In the later tests, bacteria counts, flavor and cream line determinations will also be made. Uniformity of heating is an important factor in effective pasteurization so as to have all milk reach the desired temperature without raising a portion of it to a point where the cream line will be impaired. The effect of sloping electrodes, size and shape of electrodes and shape of container on the uniformity of heating, without an agitator, will be determined. The effect of size, shape and speed, and location of an agitator on the uniformity will be determined for the most desirable container. The elimination of an agitator would be desirable if uniform results can be obtained without its use. The project was started in December, 1937, and is being carried on in cooperation with the Department of Agricultural Engineering.

ANIMAL PATHOLOGY

Bang's Disease—Udder Infection with Brucella Abortus.—Further work, using milk samples from cows showing suspicious agglutination reactions, by cultural methods and animal inoculation tests, failed to reveal the causative organism in the udder of the individuals studied. This project was terminated during the year and replaced by one designated "Bang's Disease—Calfhood Vaccination." This is a continuation of work which has been done for several years by the field force. The herds already under study have been continued in the experiment and new ones added as time and facilities have permitted. At the present time, there are sixteen herds containing 650 vaccinated animals under observation. In previous work some animals over eight months of age were selected for vaccination, but at present only calves between the ages of four and eight months are acceptable. Examinations for udder infection in vaccinated animals have been conducted on twenty-two animals. These studies consist of cultural and animal inoculation trials.

Experiments With Infectious Enterohepatitis in Turkeys.—In preparation for further attempts to develop bacteria-free cultures of Histomonas meleagridis, growths in the new medium were developed and carried until mid-winter when they were lost. At the present time poult hatches are under way for the purpose of obtaining infected organs with which to propagate other cultures.

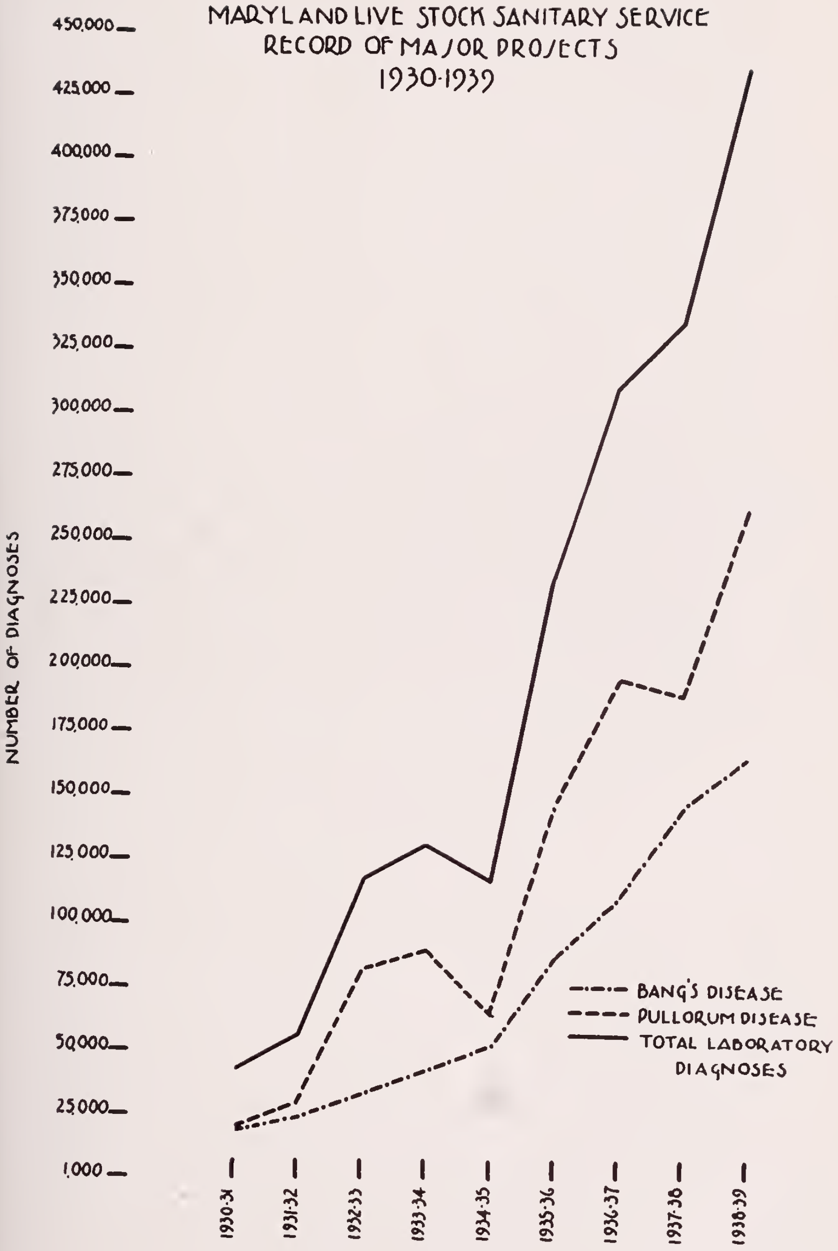
Viability of Maryland Poultry—Resistance to Pullorum Disease in Chickens.—During the past fiscal year, chicks from a Maryland Experiment Station flock of S. C. R. I. R. birds, bred for resistance during an eleven-year period (Quigley and Waite), exhibited a significantly higher survival rate during two trials out of three when compared with chicks from out-of-state pullorum clean and local pullorum-tested stock. The groups of chicks were inoculated artificially. A total of 197 chicks were used. Investigations conducted during recent months have been concerned with the identification of individual breeders transmitting resistance and with some technical aspects of the problem. A total of 1,185 chicks have been inoculated to date, in ten experiments for which all data have not been analyzed at the time of this report.

Bovine Trichomoniasis.—During the past year, trichomoniasis has been found in a few herds that had not previously had trouble. In three of the newly infected herds the source of the infection was traced to a recently added bull that came from a farm where trichomoniasis was known to exist in the herd.

Four different procedures have been followed in making diagnosis as follows: direct microscopic examination of vaginal and preputial mucous collected by means of a swab; examination of vaginal and preputial mucous which has been sedimented in physiological saline to which has been added a few drops of Lugol's iodine; cultural examination of vaginal and preputial mucous (cultural medium according to Reese); irrigation of the sheath of the bull with about one quart of sterile physiological saline and collecting the saline and mucous in a quart jar allowing it to stand for an hour or two and examine the sediment for live trichomonads. The latter method appears to be more efficient in making a diagnosis on infected bulls. A larger percentage of infected cows were found by the cultural method. It was found that cultures should be examined in 18 to 24 hours after being incubated at 35° C.

Sulfapyridine in Bang's Disease.—Sulfapyridine was used on two cows infected with Bang's disease. The drug was given in capsule in divided doses, three times a day, at an average of 43 grams per day. Treatment continued in one animal for five days and in the other, for eleven days. Concentration of the free drug in the blood 24 hours after the first dose varied from 3.6 mg.% and 4.0 mg.% in the two individuals to high points of 5.3 mg.% and 10.8 mg.%, respectively. Decline of blood concentration was virtually complete in 24 hours after the last dose. The Bang's disease blood agglutination titre in the animal treated five days showed no change, whereas that of the other rose markedly after a week of treatment and then subsided to the original level and rose again after the drug was stopped. In the case of the first animal, abortion occurred at approximately 230 days, one month after treatment. The blood picture seemed not to be influenced by the drug since the variations in total red corpuscle and white cell concentrations and hemoglobin value appeared to be within normal limits. Temperature, pulse, and respiration observations gave no significant changes from the normal to be expected under the conditions of stabling and handling.

Animal Disease Control, Livestock Sanitary Service.—The control of animal diseases is so dependent upon research activities that progress in the work is sustained only by an interdependent program. The accompanying chart indicates the extent of the service to the people of the State. It should be noted that the rapid rise in the services rendered since 1935 has been due largely to the establishment of branch laboratories in the eastern part of the State—Salisbury, Centerville and Baltimore. The College Park laboratory serves the southern and west-central sections.


MARYLAND LIVE STOCK SANITARY SERVICE
RECORD OF MAJOR PROJECTS
1930-1939
450,000
425,000
400,000
375,000
350,000
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
1,000
NUMBER OF DIAGNOSES
1930-31
1931-32
1932-33
1933-34
1934-35
1935-36
1936-37
1937-38
1938-39
BANG'S DISEASE
PULLORUM DISEASE
TOTAL LABORATORY DIAGNOSES

MARYLAND LIVESTOCK SANITARY SERVICE
RECORD OF MAJOR ACTIVITIES
1930-1939

Year	Bang's Disease Diagnoses	Pullorum Disease Diagnoses	Miscellaneous Diagnoses	Total Diagnoses
1930 - 1931	18,193	19,821	4,080	42,094
1931 - 1932	23,965	29,781	2,241	55,987
1932 - 1933	32,022	81,594	2,918	116,534
1933 - 1934	38,165	88,095	2,157	128,417
1934 - 1935	51,711	63,172	1,956	116,839
1935 - 1936	86,266	146,076	3,354	235,696
1936 - 1937	109,335	195,622	4,665	309,622
1937 - 1938	144,349	188,862	5,296	338,507
1938 - 1939	164,046	262,713	7,367	434,126

BACTERIOLOGY

Freezing Fruits and Vegetables for Commercial and Locker Storage.—The preservation of fruits, vegetables, meats and a variety of marine products by freezing offers both opportunities and problems to the agriculturist and food packer in this area. Varietal differences and climatic and soil variations produce crops of fruits and vegetables radically different from those in other sections of the country, and studies on this problem are under way in cooperation with the Horticulture Department. Furthermore, the varieties available for commercial freezing are often different from those grown in the home garden, so that the procedures worked out for commercial freezing may not be suited to freezing for locker storage, for which home grown produce is largely used. Studies of the technology of freezing are under way, including such additional problems as meat storage, and the influence of combined storage of marine products with fruits and vegetables.

Influence of "Fattening" Diet on the Intestinal Flora of Chickens.—Flavor in the tissues of chickens varies widely, some flavors being more desirable than others. The strong flavors usually objectionable are more evident in birds that have roamed the open range or farm yard than in those confined and on a controlled diet. It has been commercial practice to hold birds intended for butchering in special batteries and to provide a special fattening or "buttermilk" diet. This special diet is laxative and is instrumental in markedly reducing the strong objectionable flavors within a relatively few days. The influence of this diet has been attributed to various causes, such as the presence of the acid buttermilk "neutralizing" the flavoring substances, or the laxative effect causing a flushing action sufficient to remove the flavors. Both proposed explanations recognize the intestinal tract as the source of the objectionable flavors. It appears logical therefore, that bacterial putrefaction within the intestinal canal produces protein decomposition products which when absorbed, yield the strong flavors in the tissues. When the Spring Hill Poultry Farm, which was stocked with several thousand laying hens that were confined in individual cages and had never been free on the open range, became available to the Agricultural Experiment Station, the microflora of the intestinal tract under the prevailing conditions (pellet diet), and the influence of a change in diet upon that microflora, were studied in a number of birds. After developing a special technique of three locations of the tract, namely the duodenal loop, or "A" section; the ceca, or "C" section; and a "B" section equal to the duodenal loop in length but located at a point midway between the loop and the ceca, it was found that on the pellet diet, (1) that A or upper section contained moderate numbers of putrefactive aerobic bacteria, moderate though variable numbers of colon group (determined as typical colonies on Endo medium—actual identification not made) bacteria and moderate numbers of putrefactive anaerobic bacteria; (2) the B or middle section contained somewhat higher numbers of putrefactive aerobes, a little higher though still variable number of the colon group, and the same number of putrefactive anaerobes; (3) the C section or ceca showed considerably higher numbers of putrefactive aerobes, slightly higher numbers of members of the colon group, and the same moderate numbers of putrefactive anaerobes. After the buttermilk diet had been introduced the examination of another set of birds showed decided differences. (1) In the A section the putrefactive aerobes had almost disappeared, and the colon group bacteria and putrefactive anaerobes showed definite reductions in numbers, (2) in the B section the putrefactive aerobes and the members of the colon group did not change materially, but the putrefactive anaerobes showed a definite reduction in numbers, (3) in the C section or ceca, the putrefactive anaerobes remained unchanged from the condition noted on the pellet diet. However, the putrefactive aerobes showed a moderate though definite increase, and the colon group bacteria showed a marked increase over the counts obtained with the pellet diet. Thus the change in diet shows a direct influence on the bacteriology of the intestinal tract of the chickens. The explanations and interpretations must await further studies.

The Influence of Different Micro-organisms Upon the Quality of Frozen Egg Products.—Frozen eggs are used extensively as emulsifying agents in food manufacture. As such the physical and chemical properties of the egg meats become of paramount importance. Since frozen egg meats represent many dozens of eggs from different sources and variable qualities, little thought has been given to the variations in emulsifying powers produced in egg meats during normal preparation, packing and utilization. That such properties would be affected by microbial activity seems logical, so that a study of the types of micro-organisms occurring in frozen egg products, and the metabolic changes they bring about, was undertaken. After egg meats are frozen the greatest opportunity for bacterial development under normal methods of handling appears to be during and immediately following the defrosting procedure. Various methods of defrosting are now in use, such as allowing cans of frozen eggs to stand at room temperature, or immersion in warm or cold water. Allowing the 30-pound cans to stand in running water at a temperature of 10-15° C. appears to be accepted as the best procedure now in use. Through the cooperation of a commercial bakery the bacterial activity during defrosting was determined. The process consisted of placing the 30-pound cans in running water at a controlled temperature of 11° C. for 25 to 30 hours. Analyses showed that during defrosting marked bacterial growth occurred, rising to several hundred per cent above the original count. A new method of defrosting was developed by which an entire 30-pound can of egg meats was completely defrosted within nine hours at the same temperature. In this time very little microbial development took place. Also from general physical condition the new type of product appeared to be superior in texture. Further studies are needed to determine the influence of such bacterial growth upon the properties of the defrosted egg meats and the value of the method of rapid defrosting upon the chemical and physico-chemical characteristics.

BOTANY, PLANT PHYSIOLOGY AND PATHOLOGY

Physiological and Biochemical Aspects of Vegetable Storage.—Under this project a study was started last summer on the physiology of the curing and storage of Maryland Golden sweet potatoes. The variety has many excellent qualities as a Maryland crop, but it is a very poor keeper. The first purpose of this study was to discover the changes that occur in sweet potatoes during curing, particularly in this variety, that make them less susceptible to parasitic diseases. With this knowledge at hand, the next step was to determine the external conditions of curing and storing which are most favorable for bringing about these changes. The problem involves both physiological and biochemical studies. Selected samples of last summer's crop of Maryland Golden potatoes were cured at two temperatures, one being much higher than usual, as it is thought by at least one grower that an unusually high curing temperature gives the best results with this variety. The potatoes were also subjected to both moist and dry storage at both curing temperatures. We found quite unexpectedly that the roots of this variety, at least for this particular year, keep much better in storage when they are cured under moist conditions. Physiological studies involved respiration experiments, also experiments to determine the rate of physiological shrinkage under the different conditions by comparing the loss of weight of potatoes with the loss of weight of standardized atmometers. The biochemical work included extensive studies of nitrogen metabolism during curing and storage of the kind not yet reported on sweet potatoes. Changes in the polysaccharides were also followed under different conditions of curing and storage. We are focusing attention particularly on the changes in the pectic materials as these changes may be more closely related to the susceptibility of sweet potatoes to storage diseases. The storage period has just ended so we have not yet completed all of our chemical studies although a great deal has been accomplished during the past year on this analytical work. The physiological studies are just about completed, but the results are not yet in shape to draw definite conclusions. We expect to repeat this work next year on this same variety, and, for the purpose of comparison, include another variety which is known to be a much better keeper in storage.

The Relation Between Vernalization and the Activity of Plant Growth Regulators, Flowering Substances, etc.—Treatments which cause early flowering indirectly and directly, and the changes occurring in the plants as a result of these treatments, have been studied. Solutions of growth substances have been compared with dusts of various carriers such as talcum, diatomaceous earth, and carbon. The range of tolerance is wider in the last because the powders give off the regulators more slowly than do the solutions.

Seed treatments change the root and shoot growth, and consequently, the time of flowering. Since some reports on field experiments contained negative results, it was thought that this was due to the deficiency of some elements in the various soils. Therefore, Shive's method of sand and water cultures was used. However, the irregularity of the nutrient supply by the capillaries made dependable yield measurements impossible and the results of five months' culture only indicative. Therefore, a turntable has been devised which allows the use of a modified Raines metering pump. In this way all plants obtain exactly the same amount of liquid, which can be modified at will. Moreover, the time required for running the cultures has been cut down to about one-tenth of the time previously needed. Cost of equipping one table is about $3.00 (not including the crocks). The new experiments are still in progress.

The changes in the plant as a result of treatment appear in four classes, namely, changes in root initiation, root elongation, shoot initiation, and shoot elongation. These changes are correlated with changes in flowering time. Therefore, these changes have been studied first.

Root initiation: An effect of increased root initiation resulting from the increased uptake of mixtures has been found by the use of thiourea-napthalene acetate mixtures obtained from Mr. F. D. Jones. This has enabled the rooting of plants which would not have grown otherwise.

Root elongation: (1) Thiourea solutions increased root elongation of the seedlings of tomatoes, lettuce, etc. (2) Root tissue cultures showed that thiourea mixtures compare favorably with vitamin B_1 (supplied by Merck & Co.) in its root elongation capacity. (3) Mixtures of thiourea decrease damping off, both by action upon the seedling and upon fungus. These three points seem to indicate the practical value of these treatments for grasses to be used in lawn and golf green maintenance.

Shoot initiation: Denny has reported shoot initiation with thiourea. Some effect was noticed in the treatment of dormant rose cuttings, locust cuttings, and sweet potato tubers, as well as dormant lateral buds of various greenhouse plants (Bryophyllum, etc.). However, phenyl-ethyl barbiturate and phenyl-2-sec-amyl barbiturate (nembutal) caused pronounced shoot development in roses. These two substances also cause curvature of oat coleoptiles and increase root initiation. Thus, a new and active group of growth regulators has been found, which affect three of the four classes mentioned here: namely, root initiation, shoot initiation, and shoot elongation. Preliminary experiments on the preservation of fresh plant material (cut flowers, etc.) by these substances indicate promising results. This preservation of fresh plant material can be placed under Class 3.

Shoot elongation: Increased shoot elongation is caused by thiourea-naphthalene acetate mixtures, as is shown by the oat test, and by phenyl-ethyl barbiturate, phenyl-2-sec-amyl barbiturate, and phenyl-ethyl malonic acid, a possible derivative.

The modifications brought about by various treatments change the metabolism of the cells, and also the transportation of materials in the plant. This change of transport is partially due to the changed metabolism and partially due to changes in permeability and similar physical processes. In order to measure the changes in metabolism, the polarographic method has been modified for plant respiration work. This method allows measurement of the change of respiration of *one* oat coleoptile in two-minute intervals. Thus, an easy method to distinguish between substances which act upon metabolism and those which only change permeability or another physical condition in the plant has been obtained. To measure changes in transport as a result of various treatments the protoplasmic streaming which is one factor of the necessary means of translocation of substances in living cells, has been measured by photographic means. This has necessitated the construction of a device which allows objective measurement of particle movement in a dark field under constant conditions of temperature, light and medium. Measurements of this type have hitherto been made by subjective determinations.

To the indirect means of inducing flowering have been added attempts to extract florigens from vernalized plants (vernalized by cold, light and those of the above mentioned chemicals, which were found to cause early flowering indirectly). On the other hand, chemicals have been added which were thought to have a direct florigenous effect. These experiments are still in progress.

The Time Rate of Oxygen Respiration in Some Cereals in Relation to Total Natural and Imbibed Water and to the Ratio of Free and Bound Water.—A study was made of the relation between total natural water and oxygen respiration in developing and maturing kernels of Leapland wheat. The first measurements were made when the kernels were 2 to 3 mm. in length and having 75 per cent total water. Thereafter the measurements were made daily until the grain was fully mature. This study was carried out preliminary to the investigation to be done in 1939 when the freezable and unfreezable water components of the total water will be studied in relation to the oxygen respiration. A study was made on the relation of freezable and unfreezable water and total water to the oxygen respiration in developing and maturing kernels of Stowell's Evergreen sweet corn. A similar study was made on the developing and maturing kernels of Golden Green field corn. Imbibed water studies were made on mature Leapland wheat. The time rate of change of total water, freezable and unfreezable water, and oxygen respiration was determined over a period 22 to 28 hours on lots of seed ranging in total water content from 22 to 30 per cent. Imbibed water studies were also made on mature Minhardi (hardy), Turkey (intermediate), and Leapland (least hardy) wheats. The time rate of change of total water, freezable and unfreezable water, and oxygen respiration was measured on seed containing from 25 to 27 per cent total water.

Summary of Results to Date: (1) The intensity of oxygen respiration in ripening sweet corn falls more rapidly than the total water. When the corn has ripened to the point when it contains 50 per cent total water, there is a rapid decrease of the freezable water, ratio of freezable to unfreezable water, and the rate of respiration. (2) Throughout the entire ripening and maturing process, the data for the field corn indicate a close parallelism of the oxygen respiration to the fall of freezable water, total water, and ratio of freezable to unfreezable water. (3) Ripe Leapland wheat soaked in water for 1, 2 and 3-hour periods imbibed 22.95, 25.46, and 29.38 per cent total water (as per cent of soaked-up weight) respectively. (4) In the three samples the time rate of change of the total water content over a period of 22 to 28 hours after soaking showed no greater loss than 0.65 per cent. (5) The time rate of change of the oxygen respiration was very considerable in the three samples. The time rate of change of freezable water and ratio of freezable to unfreezable water is also great. (6) The results show a striking parallelism between the time rate of respiration and the ratio of freezable to unfreezable water. (7) Imbibed water studies made on a hardy variety of wheat, Minhardi, and an intermediate between Leapland (relatively unhardy) and Minhardi, the Turkey variety, showed the same general phenomena and trends, but the parallelism between the ratio of freezable and unfreezable water and respiration was not so striking as that shown with the Leapland variety. (8) The relative hardiness of the varieties is borne out in the imbibed water studies, the most hardy variety having the smallest per cent of its total water freezable, the least hardy having the greatest per cent freezable and the Turkey variety taking an intermediate position. (9) In the 22 to 28 hour period following the time of soaking another interesting trend is shown. The most hardy variety loses the greatest per cent of its freezable water and shows the greatest per cent loss of respiration. The least hardy variety shows the least per cent loss of freezable water, the Turkey variety again taking an intermediate position.

Cytogenetic Studies in the Genera Gladiolus, Tulipa, Ipomoea, and Verbena.—The current year's work with Gladiolus and Tulipa has been devoted chiefly to extending the data concerned with hybridization and certain cytological problems which have arisen as a result of this. The work on the other two genera is now dormant.

Gladiolus: The previously known fact, that there is no correlation between chromosome number and successful hybridization in the group other than the number of seeds produced or the number of crosses necessary to produce these seeds, has been further emphasized and extended. Previous work has been predominantly between two distinct forms, such as a commercial variety and a South African species. Now we are crossing two hybrids together, and even though the original chromosome number relations have not been disturbed, the type of germ plasm which must be concerned in such combination hybrids is more diverse. Hybridization in some cases is still successful. Again our study of the triploids emphasizes that these are far from sterile. It is true that the number of seeds is small, yet those which are flowering for the first time this year are behaving exactly like earlier triploids, even though their parentage is entirely different. The inclusion of some typical American varieties which were forced into flowering by artificial light has not changed the results. Such offsprings from the triploids have been examined cytologically and they are aneuploids. Some of them have flowered this season, and it appears that they in turn can be crossed with other diploid and tetraploid forms. These results are only tentative because the pods now being formed may be entirely devoid of seeds. This is the bridge over which any species trait must pass in order to be included in the summer flowering ones. The matter of fragrance in Gladiolus has been the subject of attention by many commercial and amateur hybridizers of this group. Incidental to our main line of attack we have included some of these species and have fragrance carried through to a form which includes three species. With the pathways pointed out above, there is a possibility of eventually including fragrance in types similar to the commercial types. Our experiments with colchicine have been outwardly unsuccessful. In other words, we have run three different series with no apparent results from the outward appearance of the plants. However, since these are only in the seedling stage, that is not a good criterion because regardless of chromosome number most gladiolus look the same in their early stages of growth. It is hoped in this connection to make certain diploid species and hybrids become tetraploid and then in one hybridization cross them with the commercial types and give equal doses of inherited material in comparison with the single dose contributed by the diploid.

Tulipa: We are continuing our study of chromosome structure and its relation to the matter of hybridization. While involved in this long time problem, we are working out certain cytological phases of the diploid-triploid problems which have turned up. When such crosses are productive of offspring, they are different depending on whether the triploid or diploid was used as the male parent. We know the nature of gametes formed in the male part of the triploid but are examining the cytological nature of embryo sac formation in the same form to see what happens. This problem is partially complete, but material must be secured this spring to determine certain older stages which we have not seen.

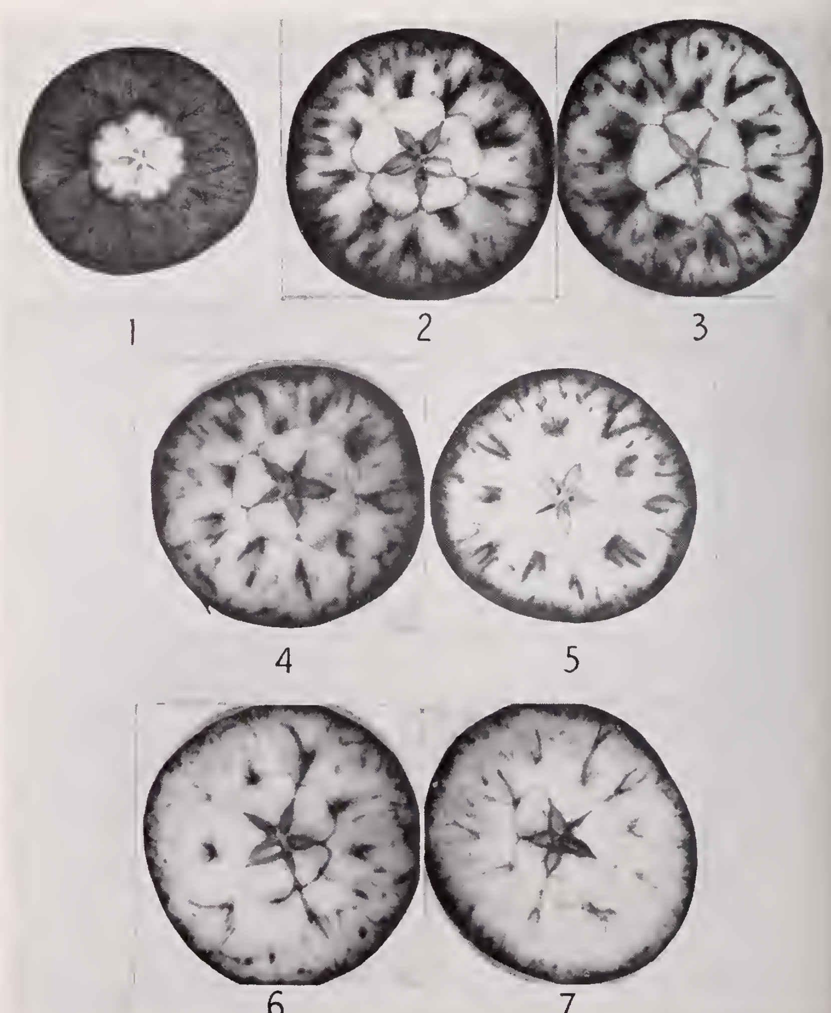
The Physiology of Plant Virus Diseases.—For the first time, it has been possible to follow simultaneously over short periods of time, the multiplication of a virus and the respiration of the same tissue in which that virus is developing. Graphs have been prepared to show the rate of oxygen uptake in virus infected and healthy tobacco tissue plotted in comparison with the mosaic-virus content of the same tissue from 0 to 360 hours after infection. It is believed that the results allow a more precise evaluation of the effect of virus multiplication on respiration than has hitherto been possible. The results indicate that the multiplication of virus protein per se causes very little alteration in the respiration rate. Certain qualitative changes in the respiratory mechanism, however, are indicated. Several new concepts of plant respiration have been developed as a result of these studies. Dr. H. G. duBuy has cooperated in all of this work and deserves particular credit for the work on respiration of the normal tissue. The results of these joint experiments have confirmed the data previously obtained by use of an apparatus for precise measurement of protoplasmic streaming (cf. last year's report) as an index of respiratory activity in individual healthy and infected cells. Further studies are being carried on to determine whether or not the virus mechanism is dependent in any way on the respiratory mechanism of the host. The data of these experiments on respiration will aid in the development of technics for the destruction of viruses in living plant tissue (e. g. to rid clonal planting stock of infection), and in developing attenuated strains of viruses for use in clonal immunization (e. g. in control of potato leaf roll).

Dissemination and Control of the Streak Disease of Raspberries (Preliminary Survey): The vector of the raspberry streak viruses is not known. A survey of commercial districts, particularly Washington County, showed the disease to be widespread. In one extreme case an individual field was found with over 90 per cent of the hills infected. At least two distinct types of streak occur. A form that seems to be identical with the "mild streak," briefly described by Cooley in Ohio (1933), is the most widespread and is particularly destructive. Every one of over 2000 hills in a commercial planting of Cumberland Black raspberries at Cavetown, Maryland, was carefully examined for streak. An accurate chart was made of this planting, and the distribution of insects and other pertinent data recorded.

Raspberry variety trials and fertilizer studies are of great value to growers in this Western Maryland raspberry district.

(In cooperation with several growers, experiments on the influence of roguing are being carried out.) The progress of the disease in the field will be recorded for several years. At the present time an investigation involving carefully controlled experiments in transmission of the virus seems feasible, and is urgently needed to help solve the growers' problems.

Breeding of Fusarium Wilt-Resistant Cantaloupes: Several strains of an organism agreeing closely with Fusarium bulbigenum Cke. and Mass. var. niveum Wr. forma 2, have been isolated from wilt-diseased cantaloupes collected in Anne Arundel County, Maryland. These have been compared with cultures of this Fusarium obtained from pathologists in Minnesota, Michigan, and New York. Single-spore isolations of the Maryland material have yielded strains differing markedly from each other in cultural behavior and in pathogenicity. These have been tested against cantaloupe hybrids and varieties and against watermelon, cucumber, and squash. All are pathogenic to cantaloupe, but no disease appeared in any of the other cucurbits. This is in agreement with field observations in Maryland. To furnish a basis for procedure in tests of hybrid resistance and field behavior, certain phases of parasite physiology are being investigated. Two strains of the parasite A-122 (produces "early wilt") and A-123 (produces "delayed wilt") are being especially studied. Both organisms have about the same optimum temperature for growth but differ in their temperature minima and maxima. Studies of growth over a wide range of hydrogen ion concentrations have revealed marked differences in behavior. Both strains exhibit double pH optima, but



With Jonathan apples a starch test with iodine-potassium iodide solution is a close indicator of maturity to determine the best stage for storage and edible quality. When starch disappearance reached a point between stages 4 and 5, best storage and edible qualities were obtained in 1937 and 1938. About 4 weeks elapsed before apples on the tree changed from stage 1 to stage 7.

the absolute rates of growth are different. A-122 can tolerate acid pH's better than A-123. The major optima for both lie between pH 6.0 and 7.0. Strains A-122 and A-123 also differ in their ability to utilize different sources of carbohydrate and nitrogen (organic and inorganic). This data should be useful in explaining certain observed variations in field severity of the disease, and in developing reliable tests for host resistance. These studies have been conducted in cooperation with the Department of Horticulture.

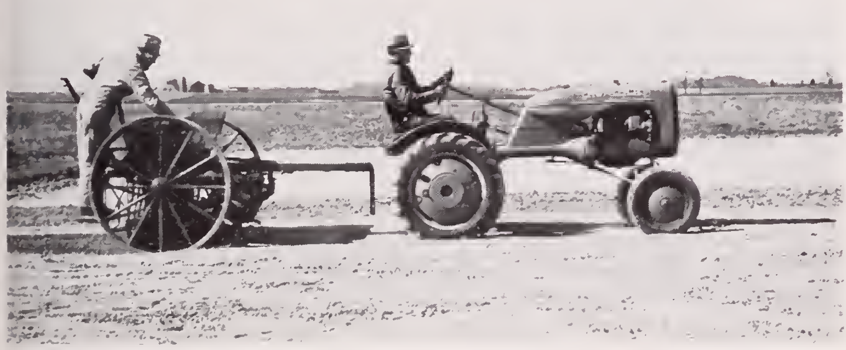
Apple Scab and Fruit Spraying.—The cooperative spray injury —apple scab project was continued this year. An orchard was selected at Mr. Hutton's farm near Ashton, Montgomery County, Maryland. It contained 120 mixed trees, 98 of which were used in the test, consisting for the most part of the Stayman variety. Spray treatments consisted of the following: pre-pink, lime sulphur 1-75; petal fall, same; first cover, micronized sulphur—8 lbs., lead—3 lbs., lime—5 lbs. The second, third, and fourth cover sprays consisted of nine substitute treatments. A total of 400 leaves were counted on each tree to determine the amount of scab infection before the second cover spray was applied. At the same time 100 apples were examined. Scab is a major factor in this orchard. Scab records will be taken on a randomized sample of 100 fruits at harvest time.

Apple Scab—Storage Scab Studies.—Apple scab development in storage was continued with the Stayman, Delicious, and Williams Early Red varieties. The field data were supplemented with anatomical studies, from which the following conclusions may be drawn. (1) Pre-storage scab lesions continue to increase in size at the cold storage temperature (33° F.), although the rate of growth is greatly reduced, and the nature of the growth is much altered. The smaller pre-storage scab lesions increase in size more than the larger ones. The activity of the fungus is confined to the margin of these spots in the form of black, zonated growth under the cuticle. (2) Typical storage scab lesions appear as small brown to black smooth, shiny lesions growing under the cuticle. With some fruits these lesions may be slightly rough on account of the abundant growth of fungal tissue under the cuticle. These two types of lesions do not break through the cuticle, nor do they produce conidia. Another type of storage lesion may have a dusty gray-black surface, which is rough in appearance. Numerous small islands of conidia may be seen on this surface. For the most part the development and growth of storage scab lesions are confined to the region under the cuticle. (3) Many isolates of the scab fungus from storage scab lesions of several apple varieties were made on malt agar. The cultures grew readily, and most isolates produced an abundance of conidia at room temperature. No isolate was entirely vegetative from such lesions. The production of conidia continued from the storage scab isolates on malt agar at room temperature, while other isolates obtained from various investigators lost this character under the same treatment and became vegetative. Several cultural and morphologically different types of the scab organism were isolated from the same, and from different apples. (4) Inoculation and washing experiments on harvested fruits that were treated and stored at once gave negative results. Fruits that were apparently scab-free when washed and inoculated remained free from scab after four months in storage. Any increase in the number of new scab lesions was not attributed to the results of inoculation. Pre-storage scab lesions continued to increase in size in storage after being washed with weak acid and soap. (5) Storage scab lesions were more abundant on the stem third of the stored fruit. Fruit apparently free from scab selected from orchards heavily infested with scab, when placed in storage without being artificially inoculated, developed numerous storage scab lesions. The infection must have resulted from late season inoculum in the orchard. The position of the apple on the tree at this time is such that any water dripping over the scab infested leaves above the apple, will accumulate conidia and carry them to the upper or stem third of the fruit, where they germinate and cause infection. (6) Thin cross-sections through a typical pre-storage scab lesion with its characteristic storage scab developed margin, as a result of being held in cold storage for three or four months, will show three or more distinct zones of fungal activity. The center of the lesion shows callus formation with cork meristem below, and with remnants of the scab fungus scattered over its surface. The gray zone around the callus center zone contains the conidia borne on thick mats of parenchymatous scab tissue, which ruptures the cuticle, and gives this zone its gray colored frayed appearance. Very slight to abundant cork formation may be found in the host tissue in this zone. In the outer black zone, the region which grew in storage, the fungus is confined under the cuticle as a thick mat of parenchymatous fungus tissue. It may be found growing intercellularly in the cortex to a depth of from 2 to 3 cells. The cortical cells below may appear distorted. (7) Thin sections through storage scab lesions show the presence of a thick mat of fungus tissue under the cuticle. The host cells including the epidermis and the upper cortical cells directly below are crushed and become necrotic. There is no evidence of cork meristem tissue in these lesions. In storage scab the fungus not only grows between the epidermis and the cuticle, but grows also in the cuticle layer in a plate-like fashion parallel to the fruit surface.

The mycelium in the storage scab lesion readily penetrates into the cortical tissue of the host to a depth of 8 to 10 cells. After entering the fruit cortical tissue the fungus grows between the cells in the region of the middle lamella in a wedge-like manner and separates the adjacent cell walls.

Varieties Resistant to Disease.—Under this heading preliminary studies on resistance to disease in any crop plant may be made. During the past two years, the resistance of tobacco to Fusarium wilt has been studied. For details of the experiment see last year's report pp. 47-48. Out of 65 varieties and strains of tobacco tested, 14 were resistant and 51 were susceptible to wilt. In the 1939 season, 5 of the more resistant strains of Maryland type tobacco were planted in large plots on the naturally wilt-infested land used in 1938 to get another check on their relative resistance and to study the relative merit of each strain as to quality. The preliminary work on the Fusarium wilt of tobacco during the past two years is promising of valuable results.

Disease Resistance in Peas.—The number of hybrid strains of canning and garden types of peas under test for resistance to wilt (Fusarium orthoceras var. pisi), root-rot (Aphanomyces euteiches), powdery mildew (Erysiphe polygoni), and blight (Mycosphaerella spp.) have been greatly reduced by eliminating about 1500 of the more susceptible and otherwise less desirable lots. The more promising strains have been multiplied in the greenhouse and in a two-acre field at Oakland. Special attention has been given to the development of extra early sweet varieties as a substitute for the starchy Alaska type now

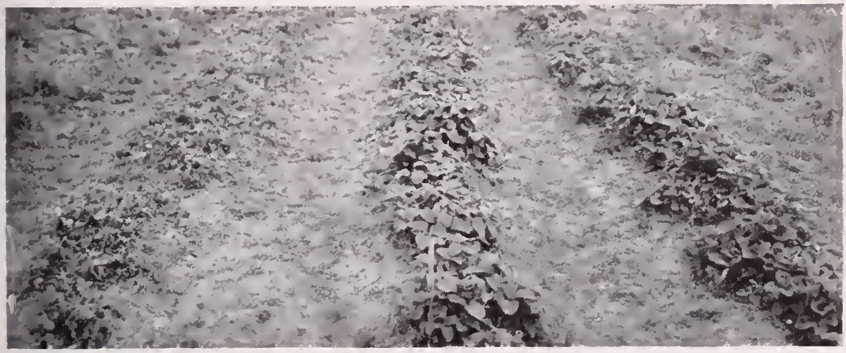


Fertilizer placement by machine for peas (as above) and other vegetable crops is the newer way to make most efficient use of fertilizers for a given crop.

Superalaska peas show somewhat greater vigor than other strains of Alaska which is correlated with greater yields under Maryland conditions.

extensively used by the canners, and a few of the hybrids seem to hold some promise for the freezing industry and for market gardening.

Strawberry Root Diseases.—During the past year special attention was given to the investigation of the red stele root-rot caused by an unnamed species of Phytophthora. Scouting and inspection of strawberry fields covering about one thousand acres indicated that approximately 30 per cent of the acreage had some plants infected with the red stele root-rot, and also, that this disease is more destructive in low, wet, black soils than it is in the high, well-drained, sandy soils. The disease in Maryland has never been identified earlier in the year than November 11th. Sixty-nine varieties furnished by nurserymen and 31 numbered strains supplied by strawberry breeders of the U. S. Department of Agriculture and five state experiment stations were tested in replicate plots for resistance to the red stele root-rot disease. This test, which covered only one year, gave the following results. Three varieties, Aberdeen, Beauty, and Pathfinder, are highly resistant, possibly immune, to red stele. Seven varieties, Dunlap, Cooper, Gibson, Marshall, Mastodon, Wayzata (Rockhill), and a hybrid selection furnished by H. W. Anderson of the Illinois Agricultural Experiment Station, are resistant to red stele. The remaining 90 varieties and strains are all susceptible to red stele. In the first group no symptoms of red stele could be found in any of the roots, and all three varieties fruited normally; in the second group, the fibrous roots and the tips of the larger roots decayed, and all varieties produced only 50 per cent to 75 per cent of a normal crop; in the third group, all plants were severely affected by red stele, and not one variety out of the 90 produced any fruit of commercial size. Crosses have been made in cooperation with George M. Darrow of the U. S. Department of Agriculture, between the resistant

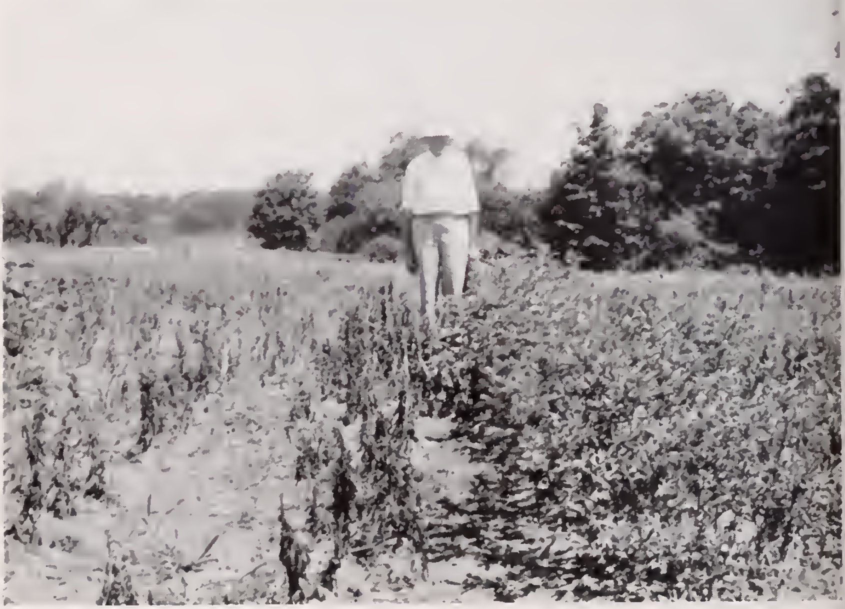


Resistance to red stele root-rot of strawberry, showing from left to right: Howard Supreme, very susceptible; Mastodon, resistant; and, Pathfinder, which seems to be immune.

varieties and the more extensively grown commercial varieties, such as Premier, Dorsett, Fairfax, Chesapeake, Mastodon, and others. From these crosses have come about 5000 clons which are being tested for resistance to red stele in naturally infested soils. The data obtained to date on a limited number of hybrids indicate that the progenies of crosses of Aberdeen by Dorsett and Fairfax are approximately 50 per cent immune and 50 per cent susceptible.

Potato Seed Improvement and Disease Control.—This project is being carried out in cooperation with the Department of Horticulture. It has for its objects (1) the study of the best methods for maintaining healthy, vigorous seed potato stocks in Maryland; (2) comparison of different potato varieties and various seed sources with special reference to susceptibility to diseases; (3) determination of best methods and best materials for the control of potato diseases. Work was begun on the project in 1932 in Worcester County, and in 1935 it was extended to Garrett County. Experiments have also been conducted in Prince George's, Howard, Anne Arundel, and Washington counties. The experimental plots were planted with different potato varieties and seedlings obtained from various sources, and with home-grown seed treated in various ways. In Garrett County the experimental fields were planted in tuber units. Accurate records were kept on the prevalence of diseases, germination, stands and yields. The relative merits of various spray materials were also tested. As soon as the work progresses far enough to permit the making of definite recommendations, reports are published and distributed to potato growers. One such report is now being prepared for Eastern Shore potato growers. The following are some of the most important results which have been obtained from these experiments: (1) Spraying with Bordeaux Mixture with the addition of insecticides for insect control, has been found profitable on all potato crops grown in Maryland. In 1939 a spray made from yellow cuprous oxide with wetting and spreading agents was compared with Bordeaux Mixture on the Eastern Shore and in Garrett County. Yields from these plots were almost as large as yields from plots sprayed with Bordeaux Mixture and further experiments with this material will be conducted. (2) Seed stocks of the Russet Rural and Smooth Rural varieties have now been maintained in Garrett County for a period of ten years by tuber unit planting and roguing, and they are still comparatively free from virus diseases. (3) Seed stocks of Russet Rural potatoes grown in Garrett County for nine years yielded just as well and were just as free from virus diseases as certified Russet Rural seed stock obtained from Michigan. (4) In Maryland potato seed stocks grown at lower elevations as a late crop yielded just as well or better than seed stocks grown at elevations above 2000 feet or than northern-grown seed stock. (5) In spite of tuber indexing, tuber unit planting and roguing, the percentage of virus diseases in McCormick potato seed stock has remained high, and it is doubtful whether it can ever again be profitably grown as a commercial variety in Maryland. (6) Late-grown potato seed stock of the Irish Cobbler variety has been made to come up just as early and yield just as well as northern seed stock and seed stock grown at higher elevations, when the storage temperature was raised to the proper degree after the rest period was over. (7) The amount of disease present in the seed stock stored at low temperatures and that which was warmed up has remained practically the same. (8) The treatment of spring-grown Irish Cobbler, Chippewa, Bliss Triumph, Katahdin, Earlaine, and Warba seed potatoes with sodium thiocyanate shortens their rest period and makes possible their use for the production of a late potato crop, but with the exception of the Warba variety, stands are poor and uneven and yields are reduced. In an attempt to determine whether any other variety could be found which would respond to the sodium thiocyanate treatment as well as the Warba potato, spring-grown tubers of thirty-three seedlings obtained from the United States Department of Agriculture were treated and planted for the production of the Eastern Shore late potato crop. Six of these seedlings came up just as soon, with just as good a stand, as the Warba potato. Further tests will be made. (9) Leaf roll increased very rapidly in seed stock grown from spring-grown treated seed, indicating that fields in which the treated spring-grown seed is grown must be carefully rogued for the production of a late crop which is practically free from disease. (10) Experiments have shown the following varieties best adapted to Maryland conditions: early, Irish Cobbler and Warba; medium late, Green Mountain, Katahdin, and Chippewa; late, tidewater to 1,000 feet elevations, Dakota Red and Up-To-Date, above 1,000 feet elevations, Smooth Rural and Russet Rural. Certain new seedlings obtained from the United States Department of Agriculture are outyielding some of the older varieties. Experiments with these varieties will be continued.

Disease Resistance in Potatoes.—This project was begun in 1936, the purpose being to find or produce varieties of potatoes which are either immune or resistant to vascular discoloration, late blight, scab, and other serious potato diseases and which are adapted to Maryland conditions and suitable for market. Two acres of land were rented near Oakland, Maryland, in 1936, and the land was artificially inoculated with one of the organisms known to cause vascular discoloration. The organism was incubated ten days in 49 manure spreader loads of barnyard manure, which was spread on the field, and plowed and disked in. The field was planted to susceptible varieties which were not dug but allowed to remain in the soil with the hope that they would incubate the disease. Some wilt and vascular discoloration were present in the field in 1936, but not as much as was desired. In 1937, 743 seedling strains and varieties of potatoes were planted on the plot. Susceptible varieties were also planted throughout the field. These were dug and stored, and in the spring they were examined for the presence of vascular discoloration. The amount found varied from none to 25 per cent. Ten per cent of the Mason variety, which was used as a check, had vascular discoloration. In the fall of 1937, a truck load of potato vines which had been rogued from a field on account of the presence of Fusarium wilt, one of the diseases which causes vascular discoloration, were spread over the test field at Oakland. They were plowed and disked into the soil. In 1938 the field was planted in four-piece tuber units with 826 seedling strains and varieties. Most of the seedlings were obtained from the United States Department of Agriculture.



Potato seedlings from U. S. Department of Agriculture being tested for resistance to Late Blight at Oakland, Maryland. Smooth Rural at left; U. S. D. A. seedling at right. No fungicides were applied in this field.

The crop was dug and stored and in the spring was tested for vascular discoloration. The check plots, consisting of Smooth Rural, Russet Rural, and Irish Cobbler varieties, had approximately ten per cent of the tubers affected with vascular discoloration. Six varieties had no vascular discoloration; fifteen had slight vascular discoloration; and fourteen varieties had severe vascular discoloration. Of the seedlings, tubers of 184 had no vascular discoloration; tubers of 228 had slight vascular discoloration; and tubers of 229 had severe discoloration. The remainder of the seedlings failed to come up, or the vines died or were rogued out for the presence of diseases before the tubers set. The most desirable of the seedlings and varieties were selected for further study. The field was dusted for the control of insects and late blight, but conditions were so favorable for late blight that all susceptible varieties and seedlings were killed off before the end of the season. Further studies of resistant seedlings will be made.

ENTOMOLOGY

Oriental Fruit Moth.—Studies of the distribution and establishment of oriental fruit moth parasites in Maryland peach orchards were continued in cooperation with the U. S. Department of Agriculture. The cooperative arrangement, however, was discontinued on July 1, 1939, by the U. S. Department of Agriculture on account of lack of necessary funds.

Biology and Control of the Corn Ear Worm.—The work on corn ear worm control was conducted during 1938 with emphasis on the use of mineral oils and desilking to determine their practicability for use by market growers. The work on the use of baits as a moth poison was continued, efforts being made to secure some additional attrahent to increase the attractiveness of sugar-arsenic bait. In order to test the attractiveness of likely materials, laboratory observations were made to determine the possible feeding response by moths and tested in an olfactometer to determine if any of the materials might attract the moths, and finally the materials were incorporated with baits in the field. Desilking and the use of oils have been found to give 50 to 75 per cent control of the corn ear worm at a cost varying from two to four dollars per acre. The desilking seems best in the early season during light infestations while mineral oils give better control on heavy infestations. The studies on corn ear worm metabolism were conducted on factors influencing total weight and total water of the mature larva and the resulting pupa. These studies are designed to determine the factors concerned with winter hardiness and over-wintering of ear worm in our section. Definite results have been obtained on factors causing dormancy in ear worm pupae.

Pea Aphid.—The work on pea aphid control was continued during the spring of 1939 with more extensive experiments than carried on during 1938. Considerable progress has been made toward determining the most efficient of the rotenone bearing insecticides, there being considerable difference in toxicity among the materials available to the growers. Progress has also been made and some valuable results secured on methods of applying sprays and dusts. Information is also being accumulated regarding the timing of treatments as determined by aphid infestation, growth and vigor of pea vines. In general, derris is superior to cube as a source of rotenone. Fine grinding of cube increases its toxicity. Dusts compare favorably with sprays in killing efficiency if applied while plants are wet and if the wind is not blowing. Sprays supplied by ordinary spray nozzles give better results when high pressure is used. The results of the 1937 and 1938 seasons were published during 1938 and 1939.

Apple Insects—Apple Aphids.—The rosy aphid infestations were so slight in Maryland orchards that no investigations were conducted other than some minor tests of ovicides belonging to the dinitro-cresol group of compounds.

Codling Moth: Biology and control studies of the codling moth were conducted in a block of Williams Early Red and Delicious apples at the Horticulture Farm at Beltsville and at Hurlock, Maryland. The codling moth infestation at Beltsville was light and all treatments were about equally good with one exception. Lead arsenate and calcium arsenate at 3 pounds per 100 gallons of water both produced fruit practically free from codling moth injury. A colloidal arsenate of lead used at very high dilution was discontinued early in the season when evidence of first brood entries were noted. Studies of the over-wintering brood of larvae were made at Hurlock in a heavily infested orchard. This study was designed to determine the most likely locations on the trees and other places in the orchard where larvae may be found. Also, studies of the successful survival of larvae in the various locations were made.

Spray Injury Studies.—Spray injury studies were conducted at the Horticultural Farm in the same block of Williams Early Red and Delicious apples as were used for codling moth studies. These studies followed the same general plan of previous years except that fewer varieties were used and one of these was a summer variety. The same materials were used on both varieties which were interplanted. The Williams Early Red reacted very unfavorably to all copper salt fungicides combined with arsenicals. Plots which received two or three copper sprays dropped about 50 per cent of their foliage by August 1st. As was the case in previous years, the best finish of fruit secured on both varieties was obtained with wettable sulphur as a fungicide, used throughout the spray season. There were some sulphur burns on leaves and the fruits that were exposed to direct sun during a short period of very high temperature in early June. The results of the year's work were presented before the Peninsula Horticultural Society and the Maryland State Horticultural Society.

Ecological and Physiological Factors Concerned with the Hibernation of Insects—The Mexican Bean Beetle.—Preliminary work on the effect of temperature, moisture and food, on the development of the Mexican bean beetle, was conducted during the year. The bean beetle in the egg stage is limited in its ability to withstand high temperature and low humidity. In both the larval and pupal stages, the insect is susceptible to high temperatures. This rather limited adaptation to temperatures and humidity results often in high mortality of bean beetle populations under field conditions. Some preliminary analyses of fat and glycogen have been made. Some of the results of the first summer's work are available as unpublished material.

HORTICULTURE

Factors Affecting Maturity, Shipping and Storage Qualities of Fruits.—One immediate problem receiving attention is to determine specific indices for apple maturity based on physical and/or chemical characters of the fruit and tree which may thus render more exact measurement of correlations between stage of maturity and storage quality, shipping quality or edible quality, as well as to make possible more exact studies as to effect of environmental factors on such fruit qualities. With Jonathan and Grimes, two important export varieties subject to rigid Federal inspection for maturity, detailed studies of such maturity tests as the pressure test, electrical maturity test, ground color change, red color development, and so-called index-number have failed to show that any of these tests are sufficiently sensitive as a maturity index to be reliable for practical or scientific use. Development of red color of Jonathan may serve as a fair index to avoid immaturity, although red color **as such** has been found not essential for development of edible or storage quality. However, with Jonathan (not with Grimes) a simple test for starch using the iodine-potassium iodide method can be used, as the Jonathan fruit shows progressive depletion of starch during the ripening stages on the tree. Development of a field application of this method is planned for Jonathan. Another plan of this work at present deals with the ripening process of apples after harvest, with especial consideration of storage temperatures and water loss from fruits of Jonathan, Golden Delicious and Grimes. Shrivelling of Grimes apples occurs with early harvested fruit, even though such fruit develops edible quality in cold storage equal to fruit harvested several weeks later. A pre-ripening period of more than one week at 55 to 60° F., followed by a waxing treatment with a thin coat of miscible wax before placing in cold storage prevented the shrivelling of the fruit, and caused the development of bright, yellow color in contrast to the greenish color and shrivelling of similar samples of fruits harvested early and placed immediately in cold storage. This pre-ripening and waxing treatment has considerable commercial possibilities, but further work is necessary to consider its applicability with commercial fruit-waxing machinery now available.

An Economic Study of Peach Planting Distances.—As reported in 1938, greater spacing of peach trees than is usually practiced, which would permit not more than 75 trees per acre, has resulted in better size of fruit, greater yields, and other advantages. With the experimental planting at Colesville, spring frosts in 1938 decreased the crop to a small percentage so further yield records are not available for the past season; however, tree responses again were in favor of better spacing.

A Study of Factors Influencing the Color of Apples.—Present studies are focused on the red strains of apples. A young planting of nearly 100 bud sports bore a few apples in 1938 and should furnish some material for this work in 1939 and succeeding years. A survey of new apple plantings among fruit growers showed that red strains of old apple varieties were being planted in preference to new varieties. Such commercial plantings will offer a source of material for study in future years to determine the effect of soils and orchard locations. The advantage of high red color, but not too dark, is becoming more of a market factor during recent years of severe competition among fruits.

Plant Propagation With Special Reference to Fruits and Ornamentals.—The uprooting of trees by a hurricane which swept New England on September 21st and the removal of apple trees by orchardists in that region, afforded an opportunity since September, 1938, to observe the rooting habit of mature trees and some stock-scion relationships. Certain varieties, such as McIntosh, which were more easily uprooted, exhibited shallow root systems of a rope-like character, affording relatively poor anchorage. Sufficient evidence was accumulated to warrant a conclusion favoring the hypothesis that the apple scion does influence the character of the stock. Another important observation after the storm, not previously shown in literature of apple propagation, was clearly made—that the graft union often was not complete with no exterior indication of the poor union, which was found as trees broke off at this point. The comparatively shallow rooting of many tree species was a noteworthy observation during a month of work in Connecticut, Massachusetts, and Vermont. Later work with tractor-pulled trees in Maryland has substantiated observations made in New England. Nursery investigations are being continued on apple stocks and will be extended to include ornamental material. Orchard tests of fruit stocks recently added an extensive test planting of peach stocks at Salisbury, Maryland, in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture, and the W. F. Allen Company, Salisbury, Maryland.

Relations of Soil Moisture, Age of Plants, Spacing of Plants, and Use of Mineral Nutrients to Flower Differentiation, Fruit Yield, and Quality of the Strawberry.—Limiting the number of runner plants of strawberries for a given area of planting has resulted in greater size of plant and greater fruitfulness per acre, in spite of fewer plants retained in the beds after plant thinning, (a term preferred to plant spacing). In a more detailed weekly study, as to factors involved, the seasonal development of Blakemore runner plants under matted row and thinned row conditions with and without late summer fertilizers, showed that all plants developed roots at a rapid linear rate during the growing season, but plants in matted rows ceased this rapid development in early fall compared with continued rate of plants in thinned rows. Fertilizers applied in mid-August or mid-September were effective in promoting root development. Rapid crown development of plants occurs in the fall after an earlier slow steady rate of increase. The continued fall development of plants in thinned rows, as well as response to fall fertilizers, possibly has significance in the excellent fruiting behavior of such plants in the following spring compared with matted row plants.

Removal of Spray Residues by Apple Washing.—Although this project is dormant and no experimental plots were maintained in 1938, apple samples secured in 1937 were analyzed for lead residue and the results of 1935, 1936, and 1937 were presented for publication. This work has been concentrated on a comparison of wetting agents of possible use as aids in apple washing. All of the wetting agents, including Vatsol, Nacconol-E, Aresket, Grasselli-2A, Tergitol, and Santomerse, were effective in aiding the removal of lead residues either at room temperatures or at 100° F. in a flotation type of washer, using 1.5 per cent hydrochloric acid solution. However, not all wetting agents were equally effective under all conditions and relative results may be influenced by variety of apple, seasonal differences, and temperature of the solution.

Adaptation of Fruit Varieties and New Seedlings to Maryland.—A survey of growers conducted in 1938 to determine the extent and distribution of the newer apple and peach varieties indicates no new trend in apple variety planting. Growers who have conditions favorable for such varieties as Delicious and Stayman are planting the red strains of these varieties in lieu of other newer varieties. Ninety-seven per cent of the growers reporting newer apple varieties are growing either the red strains of Delicious or those of Stayman. Golden Jubilee was found to be the most important of the newer peach varieties now being grown in Maryland with Halehaven next in line. Over half of all the peach trees reported were of these two varieties. A further study was made of the relative blossoming and harvesting dates of Grimes and Jonathan. Again there was a wide variation in the number of days from bloom to harvest with these varieties with different growers. In 1937 most of the growers harvested Grimes approximately 138 days after bloom while in 1938 this period was, on the whole, considerably longer. While there was also considerable variation in maturity with Jonathan, there appeared to be a concentration of picking about 150 days after bloom. A new test planting of approximately 40 peach varieties including particularly those exhibiting promise under Maryland conditions and some of the more promising Maryland crosses is being made this spring on the Plant Research Farm near College Park.

The raspberry variety test planting at Rohersville, Maryland, was continued during 1938. Yield records were secured on both black and red varieties. Additional observations were obtained relative to growth and fruiting habits, comparative resistance to anthracnose, etc. The varieties added to the test last year, namely, Dundee, Evans, and Marcy have made satisfactory growth. In 1938 yields for the black raspberry varieties calculated on an acre basis in terms of quarts were as follows: Bristol 4419, Logan 3216, Black Beauty 3133, Cumberland 3001, Quillen 2552, and Naples 1867. Yields on the same basis for the reds were: Latham 7884, Chief 5706, Newburgh 5602, Taylor 4585, and U. S. D. A. No. Nine 3406. Among the blacks, Bristol is outstanding in size, quality and attractiveness of fruit as well as in yield. Naples was last in yield for the second straight year. However, it ranks second to Quillen in anthracnose resistance. Among the red varieties, the large size, high quality and attractiveness of Taylor and Newburgh berries are noteworthy. To what extent the freezing back from the tips of the canes during the previous winter (1937-1938) reduced yields cannot be determined. To date no such injury on these two varieties is in evidence for the past winter (1938-1939). It is of interest that U. S. D. A. No. 9 is proving extremely susceptible to visitation from aphids (Amphorophora rubi). A distinct preference for this over the other varieties is being noted. In consequence the plants are rapidly becoming infected with mosaic and it may become necessary to remove all of them during the coming season.

Effect of Environmental Factors and Cultural Practices on Growth and Fruiting Responses of Fruits.—With the problem of erratic fruiting behavior of Delicious apple trees, as well as the problem of maintaining annual bearing of our several apple varieties, new field studies are being started with young and bearing trees. Also, with the economic stress of competition among fruits, the possibility of inducing early fruiting as a commercial measure seems worthy of attention. Turning to the raspberry industry of Western Maryland, we find that pruning practice offers a profitable field for study, especially with new black varieties. Work on all of these points is being started in 1938.

Factors Involved in Spray Injury, Correlated With Insect and Disease Control and Physiological Effects.—Among various types of injuries to fruits, York skin-cracking is serious in many Maryland orchards and apparently is aggravated by spray materials. Field experiments in 1938 to vary such factors as light intensity, spray coverage, and other environmental conditions in a York apple orchard, where cracking is prevalent, failed to change the amount of cracking. However, limited observations were made that cracking apparently developed only on apples which in early August had a fine, netted cracking of the cuticle not apparent to the naked eye. It is felt that conditions which affect cuticle development must be studied in relation to this problem as well as other problems of spray injury.

Factors Influencing Yield and Quality in the Production and Processing of Vegetables.—*Pea Grading Studies:* During the 1938 season approximately 1,200 samples of either composite (run-of-pod) peas or the various sieve sizes were canned at the following locations in Maryland: Snow Hill, Ridgely, Westminster, Gaithersburg, and Mountain Lake Park. Tenderometer readings on run-of-pod and the various sieve sizes were determined, and maturity grade scores and alcohol insoluble solids of the samples canned from these viner loads were likewise determined. From a statistical study of these data, made by the Department of Genetics and Statistics, two methods of forecasting grades from tenderometer readings were presented to the canners in February, 1939. These forecasts will be used in 1939 by a number of canners for buying peas on the graded basis. The details of the work, with the formulas used in forecasting are given in Miscellaneous Publication No. 677.

Pea Variety and Strain Tests: The work of testing commercial stocks and newly introduced strains of peas was continued in 1938. New varieties or stocks are first tested in single plot observation trials and only those which by virtue of yield and quality demonstrate their commercial value are then placed in the well replicated larger trial. The work the past five years has demonstrated that there are no great differences between commercial stocks of Alaska peas being sold in Maryland. Superalaska appears to have a slight advantage over other strains of Alaska because of its greater vigor. A fairly large number of new varieties of sweet or wrinkled peas have been tested during the past three years. Some of these have been introduced for both canning and freezing. Some of the newest varieties have been tested only one year and the most promising as well as several new stocks, will be tested in 1939. Three varieties grown for three seasons have shown that they will produce yields equal to Alaska. These are recommended to canners for small trials and they are in order of their maturity: Mardelah, Dark Podded Thomas Laxton, and Pride. Samples of all sweet varieties were frozen and stored for ten months at —10° F. The samples were frozen dry and in brine, and at the end of the ten months period were cooked and judged for their suitability as a freezing variety. They were graded on color, texture of skin and cotyledons, surface texture, and flavor. Only three of the nine varieties tested showed any promise and these were Glacier, Dark Podded Thomas Laxton, and Laxton's Cropper. See Bulletin No. 425 for an extended report on this work.

Fertilizer Placement on Peas for Canning: Fertilizer placement and analysis tests were conducted at two locations in Maryland in 1938, one at Ridgely and the other at Allens, both on the Eastern Shore. This work was done in cooperation with the Bureau of Agricultural Engineering of the U. S. Department of Agriculture. At Ridgely, tests consisted of seven treatments with six replicates which were cut and vined according to commercial methods. Tenderometer readings were made on run-of-pod peas from each plot to determine the stage of maturity and samples were canned for quality determinations. The single-row band application of fertilizer was superior to the 2½, 3½, or drilled treatments at both Ridgely and Allens. This superiority was based upon yield of shelled peas per acre. There was no influence of placement on sieve sizes, maturity grade scores of the canned sample, or on maturity of the peas as measured by the tenderometer. There was no difference in maturity of peas between the two fertilizers 4-8-5 and 8-8-5. There was a slight increase in earliness of maturity at the closer placements, but the differences were not statistically significant. The complete details of the work are published in Miscellaneous Publication No. 683.

Breeding and Selection of a Fruitful Type of Lima Bean for Maryland Conditions.—Further tests in 1938 proved that the new "baby lima," developed at this Station and named "Maryland Thick Seeded," was adapted to the area and would produce yields equal to or superior to Henderson for purposes of canning and freezing. Small samples of this new variety were distributed to commercial seedsmen at the end of the 1938 season. Some crosses between Henderson and Giant Emerald Isle, a large green seeded pole "potato lima," which are now in the sixth generation from the cross, are producing some very interesting and promising types. Progenies of small and medium dwarf plants are producing large pods with large seed, others large pods with small seed, and two progenies are producing small pods with seed larger than Henderson. Two more seasons will be required to test the value of these new hybrids.

Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland.—The commercial adaptability and suitability for market of various new or improved types of vegetable crops are being determined annually. These trials have been conducted in past years in Western Maryland, at College Park, and at several points on the Eastern Shore. In 1938 variety trials were grown on an extensive scale at Salisbury, including such crops as tomatoes, watermelons (both resistant and non-resistant types), cantaloupes, sweet potatoes, peppers, cucumbers, green beans, wax beans, and lima beans. A complete report on the 1938 trials is given in Maryland Experiment Station Miscellaneous Publication No. 685. A cooperative variety trial on lima beans was carried out last year with a canner on the Eastern Shore. The Experiment Station supervised the selection of varieties and the planting. The plots were large and were harvested and vined in a manner comparable to that used on the regular plantings. It was found that the differences between stocks of seed produced in the West, Mid-West, or East, were not significant. The 1938 season was not ideal for setting of lima bean pods so it is believed that differences last year were due more to environment than to differences which could be attributed to strain or stock. This type of cooperative test is much less expensive than other types and the results have a direct application on the question of regional adaptation of varieties.

Effect of Certain Factors on the Growth of Tomato Plants and Quality of the Fruit.—Certain seed treatments have resulted in considerable effects on yields and growth. Treatment of tomato seeds with phytohormonetalc dust mixtures and the subsequent treatment of the plants with water solutions of either indolylbutric or naphthylacetic acid at the time of field transplanting showed that certain combinations and use of the proper concentrations may result in (1) production of a greater yield of fruit during the first month of the fruiting period, (2) earlier production of the first ripe fruit, and (3) a greater total yield of marketable fruit for the entire season. The most effective treatment under the conditions of this experiment consisted of mixing the tomato seeds before planting with a dust composed of 1 part (by weight) of napthylacetic acid and 1000 parts (by weight) of pure talc, followed by dipping the roots of the transplants into a solution of indolylbutric acid (1 part to 100,000 parts of water) at the time of field transplanting. The higher concentrations of napthylacetic acid used in the seed treatments inhibited plant growth and development. The concentration of the naphthylacetic acid solution for the transplant treatment was apparently too high to accelerate growth. Low temperature vernalization treatments of tomato seeds caused 10 to 14 days earlier flowering of plants in the greenhouse and some tendency

Tomato yields were increased by use of seed and plant treatments with growth promoting substances.

to speed up flower development. Under field conditions, earlier flowering and fruiting occured as a result of vernalization of the seed, but all effects were less pronounced than under greenhouse conditions.

Breeding and Genetics of Vegetable Crops.—The Maryland Golden sweet potato developed by T. H. White, and introduced by the Maryland Station has continued to be the outstanding dry fleshed sweet potato in the State. A very extensive cantaloupe breeding project is being carried on, and in 1938 one and three-fourths acres of various inbreds, crosses, and backcrosses were grown. One of the most promising types derived from hybridization between inbred lines was a cross of Honey Rock on Hale's Best, which was further backcrossed for two generations on Honey Rock. This hybrid was as early as the green-fleshed Anne Arundel and was quite uniform for thick orange flesh and excellent quality. An effort is being made to develop an Eastern Hale's type which will produce satisfactory commercial crops in Maryland. The extensive distribution of Fusarium Wilt in Anne Arundel County and on the Eastern Shore has necessitated the inclusion of a wilt resistant breeding sub-project as part of the cantaloupe work. An effort will be made to develop resistant types of the various crosses which show commercial promise.

Crop Management Studies with Vegetable Crops.—The most important work the past season on this project was management of pea soils and the use of cyanamid for production of canning peas. It was found that in general there was little if any difference in yield of peas which could be attributed to source of nitrogen. Cyanamid, however, turned under with rough organic matter (corn husks from canner wastes) in the fall did produce significantly higher yields than 6-6-5 applied in the spring. Cyanamid, when applied early, also produced heavier yields of peas on soil badly infested with root-rot than standard fertilizers.

The Value of Organic Matter in the Production of Vegetable Crops.—The value of organic matter for the purpose of increasing soil colloids was clearly shown in 1938 by two experimental plantings, one of tomatoes and the other of sweet potatoes. These plantings were planted in quadruplicate with two replicates of each on light sandy soil and the other two on sandy loam soil. On the light soil the best placement of fertilizer was mixing in the row before planting, whereas, on the sandy loam the best placement of fertilizer was in bands two or three inches from the plant. The yields were nearly double from the heavier soil and when the fertilizer was placed five inches from the plants on the light soil or five inches deep, the yield was approximately one-fourth. This clearly illustrates the huge losses of fertilizer by leaching on soils deficient in organic matter and low in soil colloids. The work done on fruit cracking of tomatoes has shown that one variable which is under partial control of the grower is the maintenance of a fairly uniform moisture level in the soil. Soils low in humus and soil colloids fluctuate greatly in moisture content due to environmental conditions with consequent greater fruit cracking. It has been shown that soils with a fairly high percentage of active organic matter do not fluctuate in moisture level to the extent of the poorer soils and less fruit cracking is the result. "Building up" or increasing the soil organic matter can be accomplished by the grower, which in turn will tend to improve the moisture level of the soil, and improve the quality of his tomato crop. This project was completely revised in 1938 and more specific results should be produced during the next few years.

POULTRY

Viability of Maryland Poultry—Inheritance of Inherent Vigor. —Eight matings of Barred Plymouth Rock males with Barred Plymouth Rock females and with New Hampshire females, and one reciprocal mating, have been used as a source of chicks for the study of the transmission of inherent vigor. Measures of vigor used were growth, feathering and viability to eight weeks of age. Marked differences in viability occurred among the purebred progenies of the several males used. The differences in viability among the hybrid progenies were positively correlated with the differences among the purebred progenies. In each case, the hybrid progeny from a particular male showed higher viability than the purebred progeny from the same male.

Inheritance of Resistance to Pullorum Disease: Inherent resistance of the University of Maryland strain of pullorum-resistant Single Comb Rhode Island Reds has been measured by the inoculation of chicks of this strain with the pullorum organism. Chicks from several other stocks have been used for comparison. Resistance of chicks from the Maryland strain was markedly greater than that of chicks from the other stocks tested, with one exception. One lot of Maryland-produced New Hampshires was apparently quite resistant. Check tests at the University of Illinois showed 60 per cent survival of inoculated birds from the University of Maryland strain compared with 30 per cent survival of an Illinois susceptible strain. Marked differences in resistance of chicks from different males of the University of Maryland strain were found. Chicks from one male group gave only 15 per cent survival of inoculated birds compared with about 60 per cent survival among the chicks from four other males from the same strain.

Physiology of Reproduction of Poultry.—Studies of male fertility being conducted at the Maryland Agricultural Experiment Station have as their objectives the development of methods for increasing fertility in hatchery flock matings, the prolongation of the useful sexual life of old cocks, and reducing the age at which progeny tested sires may be obtained. Of six apparently sterile Single Comb Rhode Island Red males examined, five failed to ejaculate semen when stimulated. The sixth did yield sperm. Injections of yohimbine, a drug which stimulates sexual activity, over a ten-day period increased the sexual appetite of one sterile male but failed to cause semen production. Daily injections of gonadin, a sexual maturity hormone preparation from the blood of pregnant mares, begun at one day of age, failed to induce semen production in male chicks prior to four weeks of age, though primary and secondary anatomical sexual character were grossly stimulated. Gonadin injections with males four weeks and older caused semen production in five to twenty days. Fertile eggs have been obtained by using the semen of these very young males for artificially inseminating laying hens. Chicks from such matings will be reared to determine their qualities in comparison with chicks from normally matured males. Experiments on effect of period and time of illumination on ovulation mechanism were begun.

Nutritive Requirements of Poultry.—Lots of chicks from commercial broiler flocks were tested for vitamin A storage in the liver. Several lots were found to be seriously deficient. Laboratory studies with breeding females indicate that vitamin A deficiency greatly reduces hatchability of eggs produced and viability of chicks hatched. Flavin assays of milk and milk products indicate a variation of from 20 to 30 micrograms of flavin per gram. Chick assay methods for flavin have been improved and checked with bacteriological assays. The potency of milk products and yeast products in the recently described growth promoting factor has been studied. Addition of a yeast preparation of this substance to a "good" diet led to further growth acceleration. Apparently the amount of this factor present in milk products decreases during storage. Shank pigmentation was found to be unaffected by feeding of butter color or by iron oxide. Excellent pigmentation was obtained with a simplified diet consisting chiefly of dried milk and starch, plus 3 per cent of dried cereal grass. This same amount of dried cereal grass failed to produce deep pigmentation when added to a practical broiler mash. Some ingredient of the station mash apparently inhibits the deposition of pigment. The identity of this ingredient is being sought.

The Efficiency of Poultry in the Utilization of Feed.—Eight matings of Barred Plymouth Rock males with Barred Plymouth Rock females and with New Hampshire females and one reciprocal mating have been used as a source of chicks for the study of the inheritance of feed efficiency. Feed efficiency to eight weeks of age has been measured in chicks from these matings, individually, among the progenies from individual females and among progenies from the several males. There is apparently some association between rate of growth and feed efficiency. Hybrid chicks are usually more efficient than purebred chicks from the same sire. Variability among purebred progenies from the several sires was greater than variability among the hybrid progenies.

Factors Affecting Quality of Poultry Products.—Eggs of known history have been examined by all available techniques for measuring quality. Candling technique has been standardized by the use of permanently colored and uniformly lighted standards for candling grades. Permanent objective standards have been made for the measurement of internal quality. Especial emphasis has been placed on seasonal variation in eggs from the same hen and on differences among the eggs from various hens. Deterioration in quality of eggs from known individuals has been measured. Seasonal variations in candling quality are sharp and approximately simultaneous among the eggs from hens kept in similar environments. Seasonal changes in quality are apparently indicated by changes in candling appearance prior to their indication by broken-out appearance. Candling quality varies less among the eggs from an individual hen than among the eggs from a group of hens. Breeding experiments have been undertaken to determine whether candling quality may be hereditary.

SEED INSPECTION

Inspection of Seeds Sold Throughout the State.—Seed stocks in the hands of retail seed dealers and in transit were inspected to see whether they were tagged as required by the State Seed Law during the spring, summer and fall. Four hundred and eighty samples were drawn in this work. Only five lots of seeds were found that were untagged or incompletely tagged.

Examination of Samples from Seeds Sold Throughout th State.—The four hundred and eighty samples collected in inspecting the tagging of lots of seeds sold throughout the State wer examined in the laboratory as to (1) kind of seed, (2) percentage of pure seed, (3) percentage of weed seeds, (4) noxiou weed seed content, and (5) percentage of germination. Th result of these examinations was reported to both wholesale and retail dealers. The result of this project was published as Miscellaneous Publication No. 684 in March, 1939. More than ninety per cent of all the samples collected were tagged by four wholesale dealers, whose tagging reliability indices ranged from 47.5 to 78.6. The tagging reliability index for all 1938 collected samples was 62.3 as compared with 64.0 for the preceding year.

Examination of Samples Submitted to the Laboratory.—During the calendar year 1938 six hundred and fifty persons (or firms) submitted 2,908 samples to the laboratory for examination. The work with these submitted samples is now the largest project of the laboratory. The information furnished is as accurate and practical as our facilities permit. Most any lot of seed can be used more economically and intelligently if its characteristics are known.

Studies of Observed Variations Among Germination Tests.—Additional germination data were assembled during the year as other work permitted. We now have considerable information as to "normal" variation between germination tests of some of our more common kinds of seeds.

Economic Use of Seeds.—During the year considerable progress was made in preparing the data of this study for publication. Alfalfa, alsike clover, red clover, sweet clover, and timothy seed samples are being studied. The plant producing capacities of different lots of the respective kinds are found to vary over a wide range even with cleaned seeds. It is obvious that these kinds of seeds can not be used economically without taking their plant producing capacities into account.

The Bulletins Named Below Are Available for Distribution.

These Bulletins are sent free of charge to any address upon application.

EXPERIMENT STATION BULLETINS

Bulletin No. 297, July, 1928, Environmental Factors Influencing Wheat Production.
" " 318, Dec., 1929, Cannery Tomatoes—Three Years' Tests of Varieties.
" " 326, May, 1931, Effect of Applications of Sodium Nitrate Upon Apples.
" " 328, June, 1931, The Corn Earworm Biology and Control.
" " 329, Oct., 1931, Corn Silage Production.
" " 337, Sept., 1932, Organization and Management of Maryland Farms.
" " 344, Mar., 1933, Some Effects of Freezing on Milk.
" " 345, Mar., 1933, The Control of Tomato Diseases.
" " 346, Apr., 1933, The Sources of the Food Used by Maryland Farmers.
" " 347, May, 1933, Oat Variety Tests.
" " 353, July, 1933, The Factors Influencing Red Color on Apples.
" " 354, June, 1933, Rations for Calves.
" " 355, Aug., 1933, An Economics Study of 147 Turkey Flocks in Maryland.
" " 356, Sept., 1933, A Study of 70 Dairy Farms in Montgomery County.
" " 357, Oct., 1933, Part-Time and Small-Scale Farming in Maryland.
" " 358, Jan., 1934, Fertilizer Tests with Tobacco.
" " 360, Mar., 1934, Maryland Wheat for Cake and Biscuit-Making.
" " 361, Mar., 1934, Part I, Potato Seed Maintenanee.
" " 363, May, 1934, Natural Weed Fallow for Tobacco
" " 365, July, 1934, Roadside Markets in Maryland.
" " 366, July, 1934, Studies on Firmness and Keeping Quality of Fruits.
" " 368, Sept., 1934, Spray Residue Removal from Apples.
" " 370, Nov., 1934, The Physical and Chem. Properties of Red Clover Roots.
" " 372, Jan., 1935, Nitrogenous Metabolism in Irish Potatoes During Storage.
" " 375, May, 1935, Responses of the Tomato to Certain Essential Elements.
" " 377, June, 1935, Miscellaneous Studies on Poultry Grit.
" " 378, July, 1935, A Survey of the Sheep Industry of Maryland.
" " 379, July, 1935, Fattening Thin Native Lambs.
" " 380, July, 1935, The Effect of Size and Type of Ewe on Production.
" " 381, July, 1935, Tax Delinquency in Maryland.
" " 382, July 1935, Production, Marketing and Consumption of Tobacco.
" " 383, July, 1935, Changes in the Composition of Green Snap Beans.
" " 384, July, 1935, Wormseed Oil Production.
" " 386, Sept., 1935, Effect of Fertilizer Treatments on Tomatoes.
" " 388, Oct., 1935, Soft-Curd Milk Studies.
" " 389, Nov., 1935, Menhaden Oils as an Antirachitic for Poultry.
" " 391, Jan., 1936, The Relation of Physical Properties and Chemical Composition of Red Clover Plants to Winterhardiness.
" " 393, Feb., 1936, The Properties and Stability of Whipping Cream.
" " 394, Mar., 1936, Sale of Dairy Products at Roadside Markets in Maryland.
" " 396, May, 1936, Part I. The Farm Credit Situation in Maryland.
" " 398, July, 1936, Production and Feeding of Early Lambs.
" " 399, July, 1936, The Corn Earworm.
" " 400, July, 1936, The Vinegar Gnats or Pomace Flies.
" " 402, Aug., 1936, Studies of Incubation Factors in the Agglutination Test For Pullorum Disease.
" " 403, Sept., 1936, Strawberry Fertilizer Studies in Maryland.
" " 404, Sept., 1936, Dairy Herd Organization and Income on Dairy Farms.
" " 405, Oct., 1936, An Economic Study of Dairy Farms in Maryland.
" " 406, Nov., 1936, An Economic Study of Livestock Farms in Maryland.
" " 407, Dec., 1936, Marketing Fruits and Vegetables by Motor Truck.
" " 408, Jan., 1937, Report of Dairy Inspection Service for 1936.
" " 409, May, 1937, The Baltimore Wholesale Fruit and Vegetable Markets.
" " 410, Sept., 1937, An Economic Study of the Broiler Industry in Maryland.
" " 411, Apr., 1938, (Special Bulletin) Legume and Grass Silage.
" " 412, Oct., 1937, Economy in County Government.
" " 413, Oct., 1937, Some Factors Affecting the Accuracy of the Babcock Test on Composite Samples of Milk.
" " 414, Feb., 1938, Metabolism in the Corn Ear Worm. I. Studies on Fat and Water.
" " 415, Feb., 1938, Organization and Operation of Marsh Market in Baltimore and Proposed Improvements.
" " 416, Apr., 1938, Winter Barley in Maryland.
" " 417, June, 1938, Effect of Castration of Lambs on Their Development and Qnality of Meat.
" " 418, July, 1938, Does It Pay to Grade Eggs?
" " 419, June, 1938, The Plum Curculio.
" " 420, Oct., 1938, Physiological Studies on After-ripening and Germination of Fruit-Tree Seeds.
" " 421, Oct., 1938, An Economic Survey of Farm Orchards in Counties Near Baltimore, Md., and Washington, D. C.
" " 422, Oct., 1938, Standard of Living on Carroll County, Maryland, Farms.
" " 423, Dec., 1938, Manual for Milk and Cream Testers in Maryland.
" " 424, Jan., 1939, An Economic Study of Land Utilization in the Tobacco Area of Southern Maryland.
" " 425, Feb., 1939, Variety and Strain Trials of Alaska and Sweet Types of Peas for Canning in Maryland.
" " 426, Mar., 1939. An Economic Study of the Hatchery Industry in Md.
" " 427, July, 1939, The Production and Marketing of Honey in Maryland.
" " 428, Aug. 1939, Qualities of Hams and Rapidity of Aging As Affected By Curing and Aging Conditions and Processes.
" " 429, Aug. 1939, Marketing Maryland Turkeys.

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